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THE

BOTANICAL GAZETTE

EDITORS:

JOHN M. COULTER, Wabash College, Crawfordsville, Ind.
CHARLES R. BARNES, University of Wisconsin, Madison, Wis.
J. C. ARTHUR, Purdue University, Lafayette, Ind.

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BOTANICAL GAZETTE

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The Botanical Institute at Tübingen.

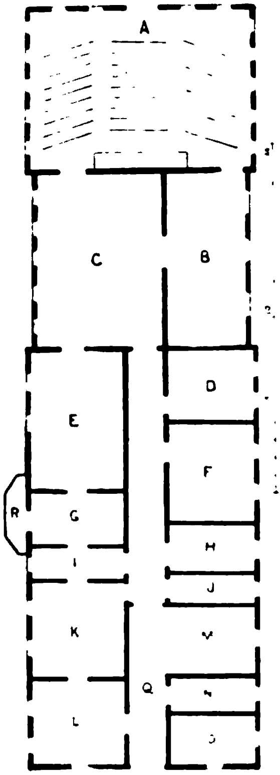
DOUGLAS H. CAMPBELL.

(WITH PORTRAIT.)

Before describing the laboratory itself it will be well, perhaps, to say a word or two about the place where it is situated. Tübingen is a quiet little south-German town of some twelve thousand inhabitants, but so compactly built that it does not cover more ground than an American village of a quarter its size. Quaint, high-gabled houses, sometimes seven or eight stories high, the upper ones usually projecting somewhat beyond the lower, and standing close together with no yards, give the place an air totally different from anything to which American eyes are accustomed. On the outskirts of the town, it is true, more modern ideas prevail, and the places look more like those to which we are accustomed.

Tübingen lies in Würtemberg, about twenty miles south of Stuttgart, on the Neckar. The scenery in all directions is charming, and makes it an uncommonly pleasant place for a summer's stay.

The university is very old, but the old buildings are no longer used, being superseded by handsome modern structures in the extreme northern part of the town. The botanical institute with the adjoining garden lies in the immediate vicinity. The institute itself is an oblong, substantially built stone



Plan of [illegible] Institute, [illegible] building occupying a street corner. Two of the sides lie directly on the street; the others are included in the botanical garden. The garden is not very large but is very tastefully as well as judiciously laid out, so that the most is made of the space. At present it is looking its best, as the leaves of the trees are just fully unfolded and the early summer flowers are in full bloom. In addition, all the portable plants have been removed from the green-houses into the open air. A small stream, a branch of the Neckar, runs through the garden and adds much to its beauty. Besides the land plants there is a very fair collection of the commoner aquatics, which are planted in a circular pond divided by stone partitions into sections for the different plants. Such a pond is, of course, extremely convenient, as many sorts of algæ and other useful water plants can be constantly kept on hand. The green-houses are well stocked, and include a large and handsome palm-house, which, however, is new, and does not yet contain any specimens of great size. Besides this, there are three other good-sized houses, as well as one or two smaller ones, and a large number of frames of small-size under which are grown such plants as require protection yet do not need artificial heat.

Owing to the kindness of Prof. Pfeffer,[1] I am enabled to give the readers of the GAZETTE a plan of the laboratory from which a good idea of its arrangement can be had.

The back portion of the building is but one story; the front has an upper story, also occupied by the professor as a dwelling. On entering the building from the rear we find ourselves at once in the large and well-arranged lecture-room *A*, occupying the whole end of the building. In this room are also some work-tables where a portion of the beginners are accommodated. Some of the windows are fitted with broad sills for the accommodation of apparatus, etc., and at the end of the lecturer's table a water-pipe has been carried up so that a supply of fresh water is always at hand; indeed, one of the most striking features of the laboratory is the abundant water supply, all the rooms being provided with one, and sometimes two sinks. In addition, a plentiful supply of rain-water and distilled water is always kept in the work-rooms.

Following the lecture-room are the two large work-rooms *B* and *C*, of which the first is occupied by beginners and the larger by Dr. Klebs, the assistant, and the students who,

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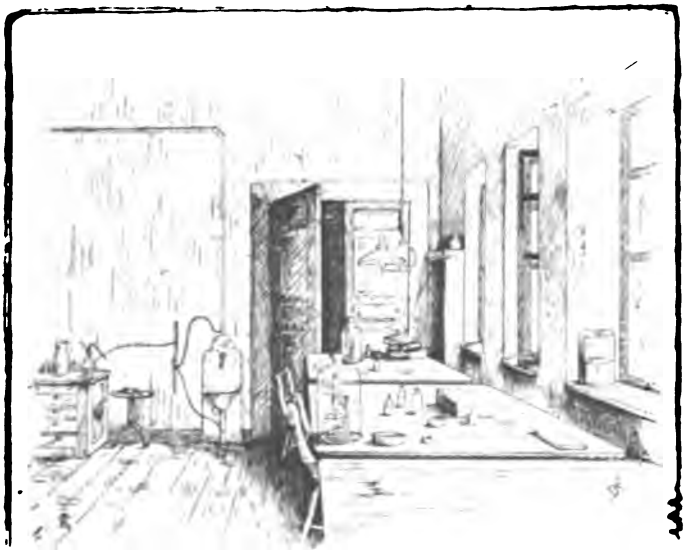
[[1] Since this article was written, Drs. Pfeffer and Klebs have both accepted calls to other universities, the former to Leipzig and the latter to Basel; while Dr. H. Vöchting, formerly of Basel, is now at Tübingen.—EDS.]

like myself, are engaged in more advanced work. Tables containing drawers and provided with the necessary appliances for work are placed near the windows and against the walls, and in *C*, in the middle of the room as well, are cases and cupboards filled with all sorts of apparatus from a paper of pins to an electric clock. The more elaborate apparatus is mostly kept in room *B*, the space in the other room being mostly occupied by such simple apparatus as one ordinarily requires, especially glass and porcelain articles of every description.



A CORNER IN THE LABORATORY.

The next room to the right, *E*, is also used by advanced students and contains most of the reference books ordinarily needed, although there is also a book-case in *C*. Between the windows in this room is a table built against the wall and free from the floor, so as to be as free from vibration as possible.

The room *F*, nearly opposite, is principally arranged for the study of bacteria, and is amply provided with all the paraphenalia connected with the investigation of these little but important organisms. Pfeffer is at present doing some work with bacteria and showed me a number of cultures he had preserved, these including some of the cholera and typhus germs. It gives me a curious sensation to look at one of these little test-tubes half filled with a harmless-looking jelly, and to think what a tremendous amount of destruction is locked up in this same apparently innocent little vessel.

IN THE GARDEN.

The print room, *O*, has its walls painted black, and is arranged so that all light can be excluded, and here experiments are conducted that must be carried on in the dark. Opening from *G* is a small green-house where plants are kept that it is wished to have ready at hand. The two rooms, *L* and *K*, are occupied by Pfeffer as his private laboratory, and, of course, are very completely equipped. Here he spends most of his time, but does not forget that he has students in the laboratory, and usually makes two or three rounds a day to see how work progresses and give necessary help and suggestions. His invariable question, "*Haben Sie was gefunden?*", grows a little monotonous sometimes, as one can hardly be expected to find something new two or three times a day.

The space *M* is occupied by the stair-case leading to the second floor, and the smaller rooms are devoted to the storing of apparatus and reagents that are not in constant use. The passage, *Q*, is lined with cases containing specimens of various kinds and also apparatus.

Everything is kept in the most perfect order under the able management of Johann, the factotum, who is always busy setting things to rights.

Pfeffer is assisted in the direction of the laboratory by Dr. Klebs. Hegelmaier, the assistant professor, has no work in the laboratory and I have seen very little of him.

I believe the laboratory was founded by Von Mohl, who was professor here for many years, and the botanical faculty also boasts of having had Hofmeister here for some time. With such men as these it is no wonder that it holds its present high rank, and the present incumbent is no unworthy successor of his illustrious predecessors.

Tübingen, Germany.

The application of the paraffin-imbedding method in botany.

DR. J. W. MOLL.

In the following lines it is my purpose to introduce into botanical science the paraffin-imbedding method which zoologists generally have employed for several years, and with great success. It will be understood that the method here meant is that in which whole organisms, or parts of them, are so imbedded as to be entirely permeated with paraffin. In fact, if the operation has succeeded well it will be impossible to distinguish the imbedded object from the surrounding paraffin except by its color. The principal advantages of this treatment especially appear when it is combined with the more excellent methods of microscopical science; for arresting protoplasm in its living form, for section-cutting and the mounting of specimens. Thus it not only enables the observer to make sections of very minute and tender objects, but also to obtain, with the greatest ease, even in very difficult cases, sections through previously determined parts of these objects, and, moreover, rigorously in the required directions. It is also possible by these means to prepare a series of consecutive sections, and it is obvious of how much use this may be in studying the development of many organs. Lastly, it is of some consequence that in sections made after this method parts which otherwise are not united to each other may still be kept in their relative positions. Thus it is possible to make thin transverse sections of buds in which the disposition of the leaves remains unaltered, and may be studied with ease. That, notwithstanding these advantages, the imbedding method has not been made use of to any extent[1] in botany must be probably ascribed to various causes. One cause of the failure of experiments in this direction may have been owing to the fact that the imbedding method was not combined with other methods; and still, as has already been remarked, this is necessary in order to insure success. In the second place no vegetable parts preserved in alcohol should be used for imbedding, as it will be often found very difficult to permeate them with paraffin. On the contrary, it is necessary to employ chromic or picric acid or mixtures of these with other substances. In such liquids fresh material should be kept for some time, and then only alcohol should be applied for withdrawing the water it contains previous to imbedding. I think that this peculiarity is connected with the presence of cellulose, which prevents the paraffin from permeating many vegetable organs, but is somewhat macerated by chromic or picric acid and other reagents. Thirdly, the imbedding method has, perhaps, been often tried in the case of full-grown parts, and with these, in many instances, it will not succeed so well. Sometimes it is difficult to permeate them with paraffin. In many cases, however, this can be attained, but even then sections made without previous imbedding are often to be preferred. Moreover, it will but seldom be necessary to have recourse to this method with adult organs, because with these it is in general easy enough to obtain all the sections required in the usual manner. Still there are cases in which the imbedding of full-grown parts is very useful, and in several instances I have succeeded in it very well.

---

[1] Only one botanist has as far as I know, employed the imbedding method, viz. Schönland, who described the beautiful results obtained with paraffin imbedding and the rocking microtome. Ein Beitrag zur Mikroskopischen Technik. Bot. Centralblatt, 1877, n. 22, p. 283.

My researches, however, speedily convinced me that the proper sphere for the application of the imbedding method, especially by those botanists who try it for the first time, is to be found in meristematic tissues, the cells of which contain but little cell-sap, a thin cell-wall, and much protoplasm, and in these respects may be compared to animal tissues. In these cases I have met with signal success, and it seems that this is not wholly without importance, as it is precisely with growing points of stems and roots that the advantages of imbedding are invaluable. I do not mean to assert that in this manner results are to be obtained which are absolutely not to be had by having recourse to the usual methods of preparing meristematic tissues for observation. It must be admitted that perseverance and patience have effected much in these matters. But it is certain that by this method the same and better results may be obtained with the greatest ease, which formerly were achieved only by comparatively few observers, with much exertion and loss of time. Thus every student may see many things which he otherwise would not have seen: longitudinal sections accurately through the median line of growing points, a series of consecutive transverse sections of the same objects, etc. And he may have such specimens in profusion, whilst every one who has been engaged in these researches knows that by following the usual methods one is often compelled to be content with a single section successfully accomplished. It is especially for this reason that I write these lines. I am convinced that it will prove useful when more observers are enabled to study the internal development of vegetable organs than was hitherto the case.

It is also very fortunate, that with the imbedding method the application of those reagents now generally employed for fixing protoplasm in its living form can be combined. Thus specimens are obtained in which the protoplasts retain, in a great measure, their original appearance. That this is the case will be admitted, when I mention that in cells with a large amount of cell-sap the peripheral protoplasm remains entirely united to the cell-wall; that the sections of growing points exhibit in the most beautiful manner the process of cell-division, with its several karyokinetic figures; and lastly, that even in the youngest cells vacuoles[2] may be distinctly seen. Formerly the investigator was often obliged to dissolve the protoplasmic contents of meristematic cells with caustic potash or similar reagents, in order to make their forms visible. Now this has become wholly superfluous, and the protoplasm may be observed in the cells of the tenderest meristematic tissue, whilst the contours of these cells are rendered as distinct as can be desired by employing the staining agents commonly in use.

In trying to apply the imbedding method to vegetable objects, I have followed the methods by which zoologists obtain their specimens, and I can not say that I have discovered anything essentially new. But still, some special precautions are to be taken. As everywhere else in microscopical research, it is difficult, if not impossible, to give general rules that will hold good for the treatment of all objects. On the contrary, it will, in most cases, be found necessary to treat different objects in a slightly different manner, and it will be the task of the observer to find out in each case which way he should follow.

Thus it seems most rational, instead of giving general, and therefore partially inexact directions, to describe a single instance at full length. If anybody should wish to become acquainted with the imbedding method I advise him to do precisely what I shall describe here, and he will easily succeed in obtaining the same results. He may then apply this method to other objects, which must, perhaps, be treated somewhat differently.

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[2] Went. Les premiers etats des Vacuoles. Archives Neerl. 1887

[illegible]

[illegible] Mixtures [illegible] especially [illegible]

[illegible]

washed out of them[4]. Then the roots must be put into alcohol, in order to replace the water they contain by this reagent. This manipulation, however, must be conducted with great caution, because the root-tips are very liable to be shrivelled.

I have no doubt that Schulze's apparatus[5] may be used here with success, but I found that it is sufficient to bring the roots, successively for some hours, or half a day, into alcohol of 20%, 40%, 60%, 80%, 95%, and finally into absolute alcohol. By these means shriveling may be totally avoided; whilst the manipulations are very simple, when bottles, containing alcohol of the concentrations required, are always kept ready and renewed from time to time.

Now, the alcohol should be replaced by a solvent of paraffin, for instance chloroform, benzol or turpentine. These fluids may be employed promiscuously, but I prefer turpentine as being the least volatile of the three. The roots are first brought into a mixture of absolute alcohol and turpentine in equal parts, and after some hours into pure turpentine, and this again in order to avoid shriveling. After some hours the roots may be put into a cold saturated solution of paraffin in turpentine. From thence the roots are removed into a mixture of equal parts of turpentine and paraffin, kept at a constant temperature of from 30 to 40° C, in an ordinary drying oven furnished with a gas regulator. After having remained an hour in this liquid the temperature is raised to from 50 to 55° C, and the roots are finally placed in pure melted paraffin, which is renewed one or two times.

I generally prefer a tolerably firm paraffin, which melts at a temperature of about 50° C. When the root-tips have remained six or eight hours in this condition one may be sure that they are wholly permeated with paraffin, and are ready for use. They now must be placed in a block of paraffin of a regular form, which may easily be held in the microtome, and they should be so placed in it as to enable the observer to make sections in the direction required. For this purpose I employ a well-known arrangement, consisting of a flat metal plate, on which are laid two Gothic-shaped pieces of metal, against each other, so as to form a rectangular mould for receiving the paraffin. I generally employ these Gothic-shaped pieces of two sizes, according to the form of the objects to be imbedded. One pair has legs of 1.5 and 4.5, another of 2.2 and 5 centimeters. Both have a height of one centimeter. The metal pieces and plate are slightly wetted with turpentine, to prevent the paraffin from adhering to their surface, and then melted paraffin is poured into the rectangular space till it is nearly filled. The root-tips have all this while remained in the drying-stove, but now they are taken out and put into the paraffin filling the mould. If this was somewhat over-heated when the operation began, and needles heated in the flame are employed, there will be ample time for arranging the root-tips in the directions required before the paraffin cools. The objects will not stick to the bottom of the mould, because the paraffin here hardens almost instantaneously on coming into contact with the cold surface of the metal. As soon as the molten mass has cooled so far as to be covered with a thin film on its upper surface, cold water should at once be poured over it, for which purpose the whole apparatus is placed from the beginning in a flat basin.

---

[4] Roots from picric acid should be washed in alcohol of from 20 to 40 per cent.

[5] Archiv. für mikr. Anat. Bd. 25, p. 342.

This sudden hardening of the paraffin serves to prevent the formation of cavities in it, which otherwise will sometimes occur and make it impossible to obtain good sections. We now proceed to the section-cutting, which should be performed in this case with a microtome. Thus only can the advantages of the imbedding method be fully enjoyed, and especially if a series of consecutive sections is made. This, if transverse, will most beautifully exhibit the whole process of development going on in the root-tip, and if longitudinal it will be very easy and save much labor to select from the series one or a few sections which have passed through the median line of the root. Though greatly preferring the arrangement of the microtomes of the Cambridge scientific instrument company, I selected an instrument constructed on less exact principles, Caldwell's microtome being beyond my means, and the so-called rocking microtome not allowing the object to be moved in the three directions of space. This, however, is often necessary in making sections of roots and other vegetable organs, especially if growing points are to be examined. I was often compelled slightly to alter the direction of the root, even at the very last moment, particularly when cutting longitudinal sections[6]. I therefore employed a microtome of Schanze, which, though in several respects a defective instrument, has not the drawback mentioned above. It should be observed, however, that this microtome is properly not adapted for making a series of sections, as the knife can not be placed in a transverse position. But this difficulty may be overcome by reversing that part which holds the object and further making some slight alteration in its arrangement, by which, however, the instrument loses still more of its stability, already not very great. Notwithstanding these objections, I succeeded in making ribands of sections well enough, if needed, keeping them flat with a piece of cross-wire held in the left hand while cutting with the right. The sections thus gained must now be glued to the slide before dissolving the paraffin. If a series of sections has been made, or sections in which parts not united to each other should be kept in their relative positions, the necessity of this method is obvious. But in almost all other cases it deserves to be applied, as it facilitates in a great measure the following manipulations of staining and mounting, and thereby enables the observer to prepare, with little loss of time, a great number of specimens. From these he may then choose at leisure the most successful ones, or those exhibiting the phenomenon sought for, and reject the rest.

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[6] Of late, however, I have become more and more convinced that with some practice it would be possible to employ the rocking microtome, and Dr. Schönland's experience (l. c.) has greatly strengthened this conviction.

The operation of gluing the sections is very simple, and may be performed in several well-known ways. As far as I know, it is best to employ a solution of india rubber, albumen or collodion. I mostly used the last two substances. When albumen is employed for this purpose the white of an egg is clipped with a pair of a scissors, the same volume of glycerine is mixed up with it, and after adding some drops of carbolic acid and filtering it is fit for use.

If collodion should be preferred, it suffices to mix equal quantities of this substance and oil of cloves. Both these mixtures do almost equally well, and are applied in exactly the same manner. A very thin layer of the fluid is spread with a camel's-hair pencil over that part of the slide (or the cover-glass) to which the sections are to be stuck. Then the paraffin sections are laid in their places and gently pressed against the slide with the brush or with the finger. After this the slides remain for a quarter of an hour in the oven, at a temperature of about 50° C. There the paraffin melts and the sections settle into the layer of gluing substance. It is also sufficient to heat the slides cautiously for one or two minutes over the flame. In both cases the slides, when still warm, are plunged into turpentine, which soon entirely dissolves the paraffin. The sections now stick firmly to the glass and the slides can pass through various liquids without the sections being detached. After having remained for some time in turpentine, this is washed out with alcohol of 95 %.

We now proceed to staining the sections, but I can not enter into many details here, which are to be sought for in works treating of microscopic manipulation.

I only observe that sections made in the manner here described require to be stained in order fully to enjoy the advantages of the imbedding method.

I will add some directions as to the staining of the specimens which we have here chosen as an example, viz., the roots of Vicia or Allium. These roots may be stained before imbedding, but in this case it will be preferable to use roots which have been treated with picric or chromic acid instead of Flemming's Mixture.

I put them for twenty-four hours into a solution of Grenacher's alum-carmine after they have reached the alcohol of 60%. After this they come again into alcohol and are further treated as described above. When the paraffin has been dissolved out of the sections by means of turpentine, it may be directly replaced in this case by a mounting medium: oil of cloves, Canada balsam or glycerine, the latter after having replaced the turpentine by alcohol.

In most cases, however, it will be preferable to proceed to staining only after the sections have been prepared as above, especially if specimens have been made in order to try the imbedding method. In the case of a single root many slides may be obtained, and thus it will be easy to try the effect of various staining reagents.

If only a general survey of the internal structure of the growing point is intended, I recommend the employment of alum-carmine, in which the slides should remain from twelve to twenty-four hours. With hæmatoxylin a similar effect is obtained, and if this should be applied at a temperature of 50° C. the process of staining will only take from ten to twenty minutes.[7] With both these dyes the protoplasm, and especially the nuclei, are beautifully colored, and the colors of the cells will be plainly discernible, so that it will be a very easy matter to make an exact drawing of the whole growing point.

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[7] I insert here a formula for obtaining in a few hours a solution of hæmatoxylin which will remain fit for use for a very long time without forming a precipitate. As it is given in a dissertation, written in the Dutch language, on a subject of pathological anatomy, it will not, perhaps, come to most botanists' notice: Three parts of hæmatoxylin are dissolved in two parts of absolute alcohol. Five parts of this solution are added, drop by drop, to 100 parts of a 3 per cent. aqueous solution of alum. This fluid is kept for two hours in a covered but not hermetically closed glass vessel at a temperature of 40° C., and after having been filtered it is immediately fit for use. Some carbolic acid is added to it, and for staining it is used ten times diluted with water.—*D. G. Siegenbeek von Henkeom*, *Pathologisch bindweefsel*, 1885.

For mounting these specimens glycerine or Canada balsam may be used indifferently, but I generally prefer the latter because the coloring matter is better preserved in it.

If, however, the observer wishes to see the karyokinetic figures with which the meristematic tissue of the root tip abounds, it will be necessary to have recourse to the coal-tar colors. With the roots already repeatedly mentioned, I obtained beautiful results in the following manner:

The slides, with the sections glued to them, are taken from the alcohol, where we left them last. They are washed for some moments in pure water and then placed in a watery solution of gentian-violet (Trommsdorff), which is procured by adding 1 part of a saturated alcoholic solution of the dye to 1000 parts of water. Here they remain for six to twenty-four hours, or at a temperature of 50° C. for a much shorter time (one hour). After this they are treated for some seconds with absolute alcohol, containing ½% or less of hydrochloric acid, then washed out well, first in water with a few drops of ammonia, (e. g. 10 drops in 300 cub. cent. of water), afterwards in neutral alcohol. Finally, the sections are mounted in oil of cloves, and afterwards in Canada balsam. Successful preparations of this kind will exhibit most beautifully the longitudinal division of the segments into which the nucleus is dissolved.

Similar, but not quite as beautiful, results are to be obtained with safranin if employed in the same manner as gentian-violet, or as Dr. H. Twaardemaher recommends:[*] To a concentrated watery solution of anilin-oil is added an equal quantity of a concentrated alcoholic solution of safranin. In this liquid the slides remain for one hour, then they are washed for a very short time in acid alcohol, and treated as above, after staining with gentian-violet. I am fully convinced that anybody who should try to prepare specimens of root-tips after the methods here described will easily obtain the same results, and if he has once seen them he will certainly apply the imbedding method in many other cases, and find it very useful. If any of my fellow-botanists should wish to obtain a notion of the results to be gained before trying the method themselves, I shall be very happy, on being applied to (Nachtegaalstraat 32), to send them a specimen. It is no doubt an inconvenience of this method that the observer must wait for some days before he can make his sections. This, however, is no serious objection, as the operations described take up but very little of his time, so that he may do other work whilst his objects are getting ready for imbedding. Moreover, if many objects are to be treated in this manner, it will be easy, by a regular distribution of labor, to have always material ready for examination. Other objects fit for trying the imbedding method on are the growing points of the stems of Vicia Faba, Elodea Canadensis, Æsculus Hippocastanum, Acer pseudoplatanus, Equisetum, etc. I also obtained very beautiful specimens by making longitudinal and transverse sections of whole plants of Mnium hornum, the first showing the antheridia and archegonia, the second showing very plainly the disposition of the leaves and their development.

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[*] Maandblad voor Natuurwetenschappen. T. 14, 1887, p. 6.

Utrecht, Holland.

BRIEFER ARTICLES.

Some results of mycological work in U. S. Dept. of Agriculture.—Among the discoveries of botanical interest as well as practical importance made through the efforts of the commissioner of agriculture the past season, the following may be mentioned:

1st. That of Greeneria (*G. fuliginea* Scribner & Viala), the fungus which causes what grape-growers term "bitter rot." The studies of this fungus were begun in the vineyard of Hon. Wharton J. Green, of Fayetteville, N. C., whose courtesy enabled very careful observations to be made upon its external appearance and effects, and, in constituting a new genus upon the species discovered, it was a pleasure to the authors to name it for Mr. Green as a mark of their esteem and respect. Later observations showed this fungus to be widely distributed over the country east of the Mississippi and westward to Texas. Under special conditions it does much damage to the crop, attacking the berries during the period of ripening.

2d. That of *Coniotherium diplodiella* Sacc., which was first discovered in Italy, in 1879, by M. Spegazzini.[1] In 1885 it was observed for the first time in France. Its distribution in this country is not known, but its present limits seem to be southwestern Missouri and northeastern Indian Territory, where it was observed for the first time the present season. Its effect on the berries has led to the use of the term "white rot" for this disease. In France, the past season, it has occasioned considerable alarm on account of the extent of its ravages.

3d. That of "Pourridie," or root rot of the grape. The root rot of fruit trees, especially of the pear, has already been noted in this country, but I am not aware that there has been any published notice of the root rot of the vine. This disease was observed in Missouri, Texas and California. It usually appears in low parts of the vineyard or where the soil is poorly drained, and is especially liable to occur where the land has been recently in forest. It was on land from whence oak trees had been removed that the disease was observed in California. Although the fungi causing the root rot of vines in this country have not been scientifically determined, they are doubtless the same as have been found in Europe, and so well studied by M. R. Hartig and by M. P. Viala, viz: *Dematophora necatrix* or *Agaricus melleus*. Magnificent growths of the latter fungus were seen by the writer in full development around dead or dying oak trees near Dallas, Texas. It is possible that this fungus is the cause of the serious losses which the fruit-growers about Dallas suffer from the "root-rot" of peach and other trees. Efforts are being made to determine whether or not this is the case.

4th. That of *Septosporium Fuckelii* Thümen. This fungus was found infesting the leaves of *Vitis Californica* growing in the cañons near Orange, California. On some of the vines the foliage was almost entirely destroyed by its attacks. It is a fungus similar in its habits and action on the host to *Cercospora vitis* Sacc., and its presence need not be regarded with alarm. It was not seen on the cultivated grapes, although it appears to be not infrequent in the vineyards of Europe. The appearance of the upper surface of the leaves attacked bears a striking resemblance to those infested with mildew (*Peronospora*), but the black spots visible on the under surface at once distinguish it from that fungus.

5th. That it is very doubtful if *Peronospora viticola* has yet been introduced into California. The districts supposed to be infested with this parasite, from the reports received by the Department of Agriculture, were found, upon investigation, to be entirely free from this disease.

6th. That of *Uromyces betæ* on the cultivated beets in southern California. So far as can be ascertained from available authorities, this is the first discovery of this disease in the United States. It is common in Europe, where it occasions some damage by diminishing the sugar product of the infested plants. It is one of the species whose life history has been fully traced, affording us the knowledge which will enable us to control it, should it become troublesome to the beet sugar interests.

7th. That the stylospores of *Physalospora Bidwellii* may remain intact in the berries through the winter, and will germinate in the spring when placed in suitable conditions. From this it appears that the ascospores are not essential to the perpetuation of the fungus. The expulsion of the ascospores from their perithecia and their subsequent germination, as seen in the laboratory of the Department, have already been recorded.

8th. That *Phyllosticta labruscæ* and *Phoma uvicola* are identical, an important fact in considering the question of treatment.

9th. That of finding the mature form of *Ramularia Tulasnei*, or *Sphærella Fragariæ*. The perithecia with their fully developed asci and ascospores were found on specimens communicated by Mr. Frank Earl. in the winter of 1886. Later, the fungus was found in all its stages on one and the same leaf. Microscopical preparations have been made which exhibit all the forms in a single section.

10th. That of finding early in December the living mycelium of *Roestelia penicellata* in the tissues of apple twigs, and its evident growth from the latter into prematurely forming leaves, for upon the latter, which were scarcely more than an inch in length, well developed spermagonia were noted December 7th. The shoot bearing these leaves had, at this date, been kept partly immersed in water in a warm room for one week. The twigs in question were from a tree which, for a succession of years, has had its foliage badly infested with the *Roestelia*. This fact was somewhat surprising owing to its isolated location, far from any Juniperus or cedar. The matter is easily explained, however, if the mycelium of the fungus is perennial within the host.

11th. That *Uredo ficus* is injurious to the foliage of the fig tree in several localities in Florida.

12th. That of finding *Puccinia pruni spinosæ*, attacking the leaves of peach trees in Texas and southern California, causing more or less injury. This fungus has been found also on the wild goose plum and the native plum in Texas, and on apricots.—F. LAMSON SCRIBNER, *Chief of the Section of Vegetable Pathology, U. S. Department of Agriculture, Washington, D. C., Dec.* 8, 1887.

A handy herbarium.—The practical study of botany is often much hindered by the amount of trouble many of us busy men find in the handling of our specimens. Many an hour's work has been turned by the present busy laborer to other studies because, having at his disposal only a few moments, so much of the time will needs be spent in hunting up what is wanted.

In this western country houses are not, as in New England, of many and large rooms. So my specimens, identified, unidentified and for exchange, have been forced, by dire necessity, to a space close under a roof, dark, low and hard to reach. It becomes, therefore, a necessity to invent something that will not take up much room, and yet will hold several hundred specimens in natural arrangement where they can be examined at a moment's notice. Here is the way in which the writer solved the enigma for a very few cents: The materials necessary are four uprights five feet high, two and one-half inches broad, and one-fourth of an inch thick; twelve pieces of the same width and thickness twenty-eight inches long; and twelve similar pieces eighteen inches long. These are to be put together so as to form a rectangular rack, on the cross-pieces of which are laid very heavy binders' pasteboards, and on these, in an orderly arrangement, the specimens are to be kept. As the inside measurement is twenty-seven and one-half by eighteen inches, specimens of ordinary size may be laid in two ranks. One can keep the left-hand row for his personal herbarium, and the right-hand for duplicates; and the size of the whole article may be modified easily to suit one's needs. To keep out the dust curtains may easily be fastened on wire so as to slide readily at the front; and permanent curtains may be tastefully fastened to sides and back, so that the general appearance will be quite ornamental, and the good wife will no more complain of those everlasting roots and herbs.—F. D. KELSEY, *Helena, Montana.*

Erigeron Tweedyi, n. sp.—Whole plant (almost silvery) canescent with minute rather soft pubescence; caudex branching, bearing many rigid, erect slender stems a span high, sparingly branched near the summit, the branches monocephalous: radical leaves thickish and firm, broadly obovate-spatulate, abruptly acuminate, rather indistinctly callous-tipped, ½ to ¾ inch long by ¼ to ½ inch wide, on slender petioles twice their length; stem leaves few and small spatulate-lanceolate: heads rather small; bracts of the involucre narrow lanceolate, greenish with somewhat scarious margins: achenia compressed, hirsute; pappus simple.—Belonging to the section containing *E. aspĕruginus* Gray, and of striking appearance for the genus. The crowded caudices and obovate canescent radical leaves much resemble those of some species of Eriogonum, and are unlike those of any Erigeron I know of. Under the microscope the hairs of the leaves, etc., have a singular appearance, being composed of two (or sometimes three) cells, the lower one being generally much shorter and of less diameter than the upper. Growing on rocky dry hills along Trail Creek, southwestern Montana, at an elevation of 6,000 feet. It is a peculiar pleasure to give this plant the name of its discoverer, Mr. Frank Tweedy, author of an excellent catalogue of the "Flora of Yellowstone Park."—WM. M. CANBY, *Wilmington, Del.*

EDITORIAL.

IN no one thing do American botanists show more negligence than in the historical study of a research. It seems to us that the *first* duty of a student is to find out what has been done by others in the line of observation selected, and the second to correct and extend those observations. One can hardly go amiss in choosing a field of work; but he may waste a great deal of valuable time in doing exactly what others have done before, time which should be spent in adding to preceding knowledge. And if he rush into print before having studied the literature of the subject, he is apt to bring discredit upon the whole number of his fellow botanists. Happily (or unhappily?) American botanists are not the only ones who are guilty of this indiscretion, but are the more conspicuous only because the literature of anatomical botany in English is so small, compared with the vast volume of it in German and French. We have frequently to complain of our German friends for neglecting English writings. But they neglect a small portion of botanical literature. If we neglect German and French and Italian we "neglect the weightier matters of the law," and, quoting English writings only, "tithe mint and anise and cummin."

It has occurred to the writer that there has been a good deal of needless decrying of botanical work when compared with that of zoologists. The latter are ready enough to claim, and botanists are too ready to concede, that the science of zoology is far in advance of that of botany. Certain methods are possible in zoology which have not yet been attained in botany, but an unprejudiced examination of the results reached in the forefront of both these sciences will reveal an advance that is remarkably uniform. We do not refer to the work done by the "rank and file," but that of well-known leaders. Zoologists are fortunate in having as their stock in trade forms of life in which man is specially interested. For instance, the public that listens with pricked up ears and discusses endlessly concerning the evolution of birds, mammals, and man, and thus brings a certain popularity to zoology, cares not a straw for the wonderful structures of lycopods and gymnosperms. One sort of compensation has been that botanists have been considered a sort of harmless folk; while zoölogists are "infidel" or "progressive," apostles of darkness or of light, according to the stand-point of the speaker. Botanical work has been no less effective and advanced in these latter days, but it lacks that possibility of spectacular display which would keep it in the mouth of the public. Monkeys and men the public wants to know about, but pteridophytes and phanerogams are decidedly prosy. It will be found, upon a fair examination, that botany and zoology are so mutually dependent and helpful that one can not advance without the other.

OPEN LETTERS.

Vitality of seeds.

In addition to the observation on this subject in Vol. XII, p. 297, the following, which I recently gave in the *Florida Farmer and Fruit Grower*, may be of interest: In the summer of 1885. a quantity of muck was taken from two feet below the surface in a marsh, and covered with a Wardian case. exposing about six square feet of surface. Only one plant germinated, *Pilea pumila*, common in the locality. The sample was taken with considerable care, but the entrance of the single seed through surface soil was not impossible. At the same time six samples of sandy soil were taken, three from the surface and three from two feet or more below. They were exposed in earthen pots, covered with panes of glass, and kept moist. The samples from the surface became covered with the grasses and weeds of the locality, and those from deeper developed nothing. A. A. CROZIER.

Department of Agriculture, Washington, D. C.

Mr. Pringle in Mexico.

All who read the GAZETTE will be glad to learn of the safe return to his Vermont home of Mr. C. G. Pringle. He has had a "hard struggle this year in North Mexico with drought and other adverse circumstances," being able to collect to advantage for only two autumn months. His field of operations was in the highlands of West Chihuahua, and, in spite of the "adverse circumstances" under which he labored, he has secured his usual quota of treasures, every specimen of which bears the stamp of the collector.

In regard to the grasses I wish to say that, considering the large number of species collected in Mexico in recent years, both by Mr. Pringle and Dr. Palmer, the number of apparently new species or forms is surprisingly large. Of the forty-five sheets of grasses of the present collection, received by me, there are thirty-five species new to Mr. Pringle's *Plantæ Mexicanæ*, and among these twelve are probably new species or varieties. F. LAMSON SCRIBNER.

Washington, D. C.

Is the strawberry poisonous?

The editorial in the November number of the GAZETTE in regard to plant poisoning leads me to make the present record of an interesting case which has come under my personal observation. A friend and neighbor, a gentleman now advanced in years, is so afflicted by the fresh fruits of the common strawberry that he is unable even to go into a room where they are without suffering serious consequences. As a boy, he was accustomed to the use of strawberries without apparent injury; but when about fourteen years of age he was taken violently and suddenly ill, accompanied by an irritating cutaneous rash, from eating moderately of field strawberries. The attack was so sudden and severe that he had to be carried from the field to the house. From this time to the present, a period of some sixty years, he has been unable to eat even a single strawberry without causing a more or less severe recurrence of the difficulty. On one occasion, some ten years after the first attack, hoping that he might have outgrown the trouble, he indulged in eating a few berries at a tea party, but was taken ill so suddenly that he was obliged to leave the table and retire to his room. where he was sick in bed for a day or two afterward. The first symptom of an attack is the appearance of the burning and itching cutaneous rash, which always begins behind the ears and spreads rapidly over the body; in the instance last mentioned, covering the whole body within an hour. Of course, he has long since learned to avoid strawberries as he would a dangerous plague; but he is so susceptible to the poisonous influence that the mere passing along the walk near a fruit stand where strawberries are exposed for sale is sufficient to cause a slight development of the cutaneous rash.

The only other case of the kind which I have ever heard of, and the only one known to the gentleman whose case is recorded above, is that of a distant relative of his, who is afflicted in a similar way. On one occasion, when visiting some friends who thought his dread of strawberries was largely or wholly a matter of the imagination, the hostess prepared some strawberry shrub, which was so disguised with other flavors as to conceal the real nature of the beverage. Of this he drank a moderate amount without knowing what it was; but he was soon taken with the worst symptoms of strawberry poisoning, his illness speedily becoming so serious that his life for a time was despaired of.

The two cases here recorded appear to be essentially the same, so far as the effects of the strawberry poisoning are concerned, the only important difference being that the susceptibility to the poison was not developed in the first case until the person in question was fourteen years of age, while in the other it seems to have been congenital.

Cornell University. A. N. PRENTISS.

CURRENT LITERATURE.

The Prothallium of Equisetum.[1]

In this monograph Dr. Buchtien gives, in the first ten pages, a very full history of the special studies of Equisetum, from Dillenius in 1717 to Sadebeck in 1879. Almost all the earlier observers, as is well known, failed to understand the relations of the reproductive parts, and all the later ones have been troubled by inability to cultivate the prothallia. Buchtien gives a detailed description of his methods of culture. The key to his success seems to be in complete sterilization, by well-known methods, of the substrata used for cultures. The remainder of the paper describes fully the spore, its germination, development of the prothallium and its trichomes, the development of the spermatozoids and the formation of the young plantlet (asexual stage). Into the details of this developmental history we have not space to enter. The paper is a model of completeness and logical arrangement, and is an important one for laboratory libraries.

Muscologia Gallica.[2]

This important work has reached its sixth part which almost completes the genus Orthotrichum. This part and a portion of the preceding and following, embracing all European species of the genus Orthotrichum, has been specially elaborated by Dr. Venturi. He shows a commendable recognition of the variability of the species of this genus, and many nominal species are reduced. Dr. Venturi's work is not only of interest to European bryologists, but is of much value to Americans, as it contains critical notes upon a number of our species. In fact, the whole work is worthy the patronage of American bryologists. The plates are good and the work is remarkably cheap.

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[1] Entwicklungsgeschichte des Prothallium von Equisetum. Von Dr. Otto Buchtien. (Bibliotheca botanica, heft 8 4, pp. 49, plates vi. Cassel: Theodor Fischer, 1887. Price, 10 marks.

[2] Muscologia Gallica, descriptions et figures des Mousses de France et des contrées voisines. By Th. Husnot. 6e livraison. Royal 8, pp. 161-192, plates xlv-lii. Published by the author, Caban, par Athis, Orne, France. Each livraison, 5 francs.

Das Botanische Practicum.[1]

No book ever came nearer to filling a long-felt want than this hand-book, which was issued only three years ago, and of which two English translations have lately been published. The fact that a revision has been so soon called for has been chiefly due to the demand for the book and the rapid advance in microscopical technique. This edition, therefore, has been completely re-elaborated; so completely that a detailed comparison with the first can not be made. A few of the chief changes may be noted. The number of "tasks" has been reduced from thirty-four to thirty-two, and the number of specimens studied has also been reduced somewhat, in order to give room for the more complete exposition of microscopical technique. Room for this purpose has also been obtained by increasing the size and number of the pages, and it has been the author's aim to develop the microtechnical portions rather than the anatomical. In this respect, therefore, the book is much stronger than before. But microtechnique, without reference to its application in scientific research, gets no countenance from the author. Important changes are also made in the chapters on the fibro-vascular system and on the bacteria, to which alone over forty pages are given. The bringing of the references from the end of the chapters to foot-notes is a great convenience. Not only is the information which one most wants *in* the book, but it is rendered thoroughly accessible by the elaborate indexes. These, already good in the first edition, have been considerably enlarged, and two new ones added. There are now, besides a very full table of contents and a list of illustrations, six indexes, covering 87 pages. The first gives a list of the plants used, indicating the parts needed and the desired condition, whether fresh or alcoholic; second, a list of the plants used arranged according to the times at which they may be obtained, a most useful scheme for the collector; third, a list of instruments and utensils; fourth, a descriptive list of reagents, stains, imbedding media, etc., with recipes and directions for preparing them; fifth, a list of necessary reagents and stains; sixth, a general index to the whole work. It is, unquestionably, the best indexed book we have ever seen. We commend Dr. Strasburger's example to his countrymen as one worthy of imitation. A number of new cuts also appear in the text of the same excellence as those of the original edition. We feel that the book can not be too highly commended. Certainly, it is indispensable to all botanists who use the microscope, and we fancy even zoölogists will find it useful.

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[1] **Das botanische Practicum**; Anleitung zum Selbststudium der mikroskopischen Botanik. für Anfänger und Geübtere. Zugleich ein Handbuch der mikroskopischen Technik. Mit 193 Holzschnitten. Von Dr. Eduard Strasburger. Zweite umgearbeitete Auflage, Royal 8°, pp. xxxvi, 685. Jena: Gustav Fischer, 1887. Price, 16 marks.

The Fern Allies.[4]

Supplementary to "Synopsis Filicum," and by the junior author of its second edition, appears this manual, and for the first time the lower pteridophytes of the world are described together in one volume. The general arrangement follows much the pattern of the familiar "Synopsis Filicum," but the type is much clearer and the quality of paper used much heavier, so that in mechanical execution the work is an improvement on its predecessor. At the head of each genus is a "clavis" (why not "key," since the descriptions are in English?), but as its ultimate divisions refer to groups containing sometimes twenty species it is not as serviceable as it might have been made. The species are classified in four orders and eleven genera, as follows: EQUISETACEÆ, 20 species, all belonging to *Equisetum;* LYCOPODIACEÆ, 98 species, distributed among *Phylloglossum* 1, *Lycopodium* 94, *Tmesipteris* 1, *Psilotum* 2; SELAGINELLACEÆ, 383 species, divided between *Selaginella* 334, and *Isoetes* 49; and RHIZOCARPEÆ 64 species, distributed among *Salvinia* 13, *Azolla* 5, *Marsilia* 40, and *Pilularia* 6; or in all 565 species, against probably 3,000 ferns, since it is stated in the preface to this work that over 700 have been described since the last issue of "Synopsis Filicum" in 1874, and this contained 2,235.

Looking at some of the genera in more detail, we find the twenty-five species of Equisetum of Milde's exhaustive monograph reduced to twenty here. E littorale is doubtfully credited to our flora, notwithstanding the fact that, in addition to the Canadian locality mentioned by Milde, we have Pringle's station in Vermont near Lake Champlain, and Wibbe's discovery of the same near Oswego, N. Y. E. telmateia appears under the name of E. maximum Lam., which is an error according to Milde, who examined Lamark's original specimen.

Lycopodium sabinæfolium appears as a variety under L. alpinum, which would seem unnecessary unless both were made varieties of L. complanatum, from which they have undoubtedly sprung. The substitution of L. obscurum for L. dendroideum is of doubtful propriety.

Selaginella tortipila is included under S. rupestris where it doubtless belongs, and S. Ludoviciana, from Alabama and Louisiana, scarcely distinct from S. apus, is recognized as a good species, so that the total number of our species remains as before.

The most glaring omission with reference to American species is, that of two of Engelmann's species of Isoetes published in his valuable monograph in 1882. This work was evidently unknown to the author, as he fails to mention it with Engelmann's earlier papers in the summary of the literature of the genus. I. Suksdorfii appears as a new species from Washington Territory, said to be easily recognized by its trilobed rootstock.

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[4] Hand-book of the Fern Allies. By J. G. Baker, F. R. S., F. L. S. 8°, pp. 159. London: George Bell & Sons, 1887.

The U. S. species of Marsilia are reduced to four, M. tenuifolia strangely kept distinct, while M. uncinata and M. mucronata are made varieties of M. vestita. Extended study of large suites of the American forms has led us to different results.[5] The error of Al. Braun (in *Berl. Monatsbericht*) in copying Engelmann's M. macropoda as macropus is here repeated, the original description evidently not being consulted.

Salvinia natans is not credited to America, yet its existence in Missouri is an established fact. Notwithstanding these omissions, the work is a valuable addition to the literature of the pteridophytes.

LUCIEN M. UNDERWOOD.

NOTES AND NEWS.

MR. W. BAKER, formerly a member of the Kew staff, has been appointed curator of the Oxford Botanic Garden.

COUNT H. VON SOLMS-LAUBACH, professor of botany at Göttingen, has accepted the position of director of the botanical garden at Berlin.

PROF. L. H. BAILEY, JR., of the Michigan Agricultural College, is delivering a course of lectures at Cornell University on horticulture.

TWO NEW GENERA of Ascomycetes are published in *Journal de Botanique* (Nov. 15) by M. Ph. Van Tieghem, under the names *Oleina* and *Podocapsa*.

ERRATUM.—After the review of Rees and Fisch's monograph on Elaphomyces, vol. xii, p. 255, append the initials W. T. The review was contributed at the editors' request.

DR. H. H. RUSBY has distributed his paper on the cultivation of Cinchona in Bolivia as a reprint from the *Pharmaceutical Record*. It was read at the last meeting of the A. A. A. S.

AN ARTICLE on the mycodomata of papilionaceous roots by Dr. A. N. Lundström in the last number of *Botaniska Notiser* is accompanied with a plate illustrating the bacterioid bodies found in the tubercles.

AN INTERESTING account of the morphology and biology of the Uredineæ by P. Dietel is being published in the successive numbers of the *Botanisches Centralblatt*, in which many American species are considered.

THE *West American Scientist* enters upon its fourth volume with continued assurance of success. Its editor, Mr. C. R. Orcutt, is doing a good work in keeping alive an interest in natural history subjects on the Pacific slope.

PROFESSOR L. VON CIENKOWSKI, of the Russian University of Charkow, well known by his studies on low forms of animal and plant life, and particularly by his memoir on the "Morphologie der Bacterien," died October 7, at Leipzig.

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[5] Cf. Bulletin Torrey Bot. Club, May, 1887.

THE COPLEY MEDAL for 1887 has been awarded to the distinguished botanist, Sir Joseph Dalton Hooker. In his address of presentation, President Stokes (of the Royal Society) gave a brief account of his place in botany, the most appreciative words being quoted from Prof. Asa Gray.

THE THIRD NUMBER of *Pittonia* (November, 1887) contains "West American phases of the genus Potentilla," the third paper on "West Am. Asperifoliæ," "Some American Polemoniaceæ," "New or noteworthy species," "Echinocystis, & Megarrhiza," and a "biographical notice of Dr. Albert Kellogg." Those interested in the botany of the Pacific slope can secure this series of papers by addressing Prof. Edward L. Greene, Berkeley, California.

ENGLER AND PRANTL'S *Die natürlichen Pflanzenfamilien* has reached its thirteenth number, and, with its array of authors, superb illustrations and low price, remains one of the most notable botanical publications of the day. The last four parts contain the following families: Amaryllidaceæ, Velloziaceæ, Taccaceæ, Dioscoreaceæ, and Iridaceæ, by F. Pax; Flagellariaceæ, Mayacaceæ, Xyridaceæ, Rapateaceæ, Typhaceæ, and Sparganiaceæ, by A. Engler; Restionaceæ, Centrolepidaceæ, and Eriocaulaceæ, by G. Hieronymus; Bromeliaceæ, by L. Wittmack; Pandanaceæ, by H. Graf zu Solms; Gramineæ, by E. Hackel.

EPIDERMAL CHLOROPHYLL is the subject of a paper in the *Journal of Botany* (Dec.) by S. Le M. Moore. Stöhr (Sitzb. der K. Akad. Wien. 1879, p. 87) had shown that out of 102 dicotyls 94 had chlorophyll in epidermal cells at some period of life. Mr. Moore found that out of 120 angiosperms 102 had epidermal chlorophyll at least on the lower leaf surface; of these, 115 were dicotyls, 101 of which had epidermal chlorophyll. Of the species with epidermal chlorophyll grains, 34 per cent. showed easily discoverable starch therein; in an additional 24 per cent., small amounts of starch could be discovered; leaving 42 per cent. with absolutely starchless grains.

IN A SHORT note in the *Biologisches Centralblatt* (vii. 510) Stahl suggests that raphides, hitherto considered as a useless excretion, are specially useful to plants as a protection against the herbivorous animals. In a series of experiments it was found that a large number of animals eat not at all or but sparingly the plants containing raphides, while some—*e. g.*, snails—eat only the parts of the plants from which the needle crystals are absent. He adds that many plants considered poisonous—*e. g.*, Arum maculatum—owe the burning taste wholly to the numerous raphides which escape from their receptacles and pierce the tongue and gums. It would be interesting to know whether the juice of our Arisæma triphyllum would lose its intensely acrid taste by filtration.

PROF. JOSEPH LECONTE, in *Am. Jour. Sci.* (Dec.), has a paper upon the flora of the coast islands of California in relation to recent changes of physical geography. His conclusions are based upon results obtained by Prof. E. L. Greene in his studies of the flora of these islands. He considers it to be proved that the islands were undoubtedly separated during the quaternary period, and that the peculiarity of the flora is due to species saved by isolation. In the case of Madagascar the separation has been very long, and the peculiarity of its flora is due partly to "progressive divergence," and partly to forms saved by isolation. As the author suggests in the closing paragraph, such conclusions can be safely drawn only after a much more exhaustive study of the species concerned.

VOL. XIII. NO. 2.—BOTANICAL GAZETTE.—FEB'Y, 1888.

DR. ASA GRAY died at his home in the Botanic Garden, Cambridge, Mass., January 30, 1888. He was born November 18, 1810. The funeral services took place at Appleton Chapel, February 2. A biographical sketch, with portrait, was published in the BOTANICAL GAZETTE for January, 1886. In the March number a suitable notice will appear, prepared by one intimately associated with him.

Undescribed plants from Guatemala. II.

JOHN DONNELL SMITH.

Chrysochlamys Guatemaltecana. (§ *Tovomitopsis*).—Arboreous, branchlets terete: leaves oblanceolate, 4-9 inches long, a third as broad, shortly acuminate, narrowed acuminately to a short petiole, chief lateral veins 10-12, younger leaves aureo-punctate and delicately reticulate with free veinlets: panicle short-peduncled, 3-4 inches long, tri-quadri-trichotomous, ultimate clusters cymose, axes complanate, bracteoles triangular and concave: flowers in specimens seen pseudo-hermaphrodite; *alabasha* round-oval, half the length of pedicels; bracts 2, ovate, 1½ lines long: sepals 4, oval, nearly equal, 3 lines long: petals 4, obovoid, a little exceeding sepals, like them striate and punctate: stamens effete, indefinite, concrete at base, equaling ovary, external ones shorter, filaments flat and linear-tapering: stigmas 5, cuneately oblong, confluent at base, exceeding diameter of 5-locular ovary.—Forests of Pansamalá, Depart. Alta Verapaz, alt. 3,800 feet, June, 1886. (Ex Plantis Guatemalensibus Tuerckheimianis, quas edidit John Donnell Smith, 989.)

Harpalyce rupicola.—A shrub: petioles 6-9 lines long, like the racemes ferruginous-pubescent: leaves 4-5 inches long: leaflets 11-15, oblong, retuse, rounded at base, 1 inch or less long, half as broad, terminal one the longest, diminishing to lowest pair one-half shorter and oval, at first puberulous above and aureo-atomiferous beneath, both surfaces soon glabrate and minutely reticulated, impunctate, margins revolute, petiolulate: racemes axillary or from leafless nodes in terminal panicles, nearly equaling leaves, 12-18 flowered, peduncle equaling petiole, pedicel 4 lines long: calyx tomentose, atomiferous, oblong-falcate, half an inch long: petals purple, auricled on one side; vexillar exceeding the others, 9 lines long, 7 lines broad, round-obovate, auricle minute; alar 2½ lines broad: carinal a little shorter, partly cohering: staminal sheath cleft to base; greater anthers linear-oblong, ¾ line long; others ovate, one-third as long: ovary linear, 1 locular, 6-7 ovulate.—Approaching *H. arborescens* Gray, the originals of which (Ervendberg 18, Coulter 556) in Harvard Univ. herb. differ by their coriaceous obscurely veined leaves atro-punctate beneath the close pubescence of under surface, short racemes of smaller flowers, biauriculate vexillum, smaller less heteromorphous anthers, and habit.—Mountain cliffs near Santa Rosa, Depart. Baja Verapaz, alt. 5,000 feet, April, 1887. (Ex Pl. Guat. cit. 1210.)

Bauhinia Rubeleruziana. (§ *Casparia DC.*)—Arborescent, 10–15 feet high, rufous-tomentose: stipules and bracteoles linear-lanceolate, 2 lines long: petioles 9–15 lines long, inserted between a pair of minute subulate smooth spines; leaves membranaceous, glabrate above except midrib and margin, pubescent beneath with tomentose veins, ovate-oblong, cordate, 4–6 inches long, two-thirds as broad, 9-nerved; lobes triangular, acute, an inch or less long, sinus nearly rectangular: racemes extra-axillary, 15–20-flowered; rhachis at length an inch long, peduncle and pedicels a third shorter: flowers andro-monœcious, chiefly with abortive pistils, pendulous in the bud: calyx spathaceous, in the bud 9 lines long and 2 lines broad, tomentose, 5-denticulate by excurrent nerves: petals linear-lanceolate, spathulate, sessile, ciliate beneath, red, diminishing from the interior one 11 lines long and 2 lines broad to the exterior one a half smaller: stamens all shortly connate, each with a hirsute process on the inside near its adnation; the fertile 1, equaling petals, glabrous; the sterile about half as long, unequal, ciliate: pistil tomentose, exceeding petals; stipe nearly as long and style half as long as the linear 12-ovulate ovary.—Banks of Rio, Rubeleruz, Depart. Alta Verapaz, alt. 2,500 feet, April, 1886. (Ex Pl. Guat. cit. 896.)

Bauhinia Pansamalana. (§ *Casparia DC.*)—Smooth throughout: stipules and intrastipular spines minute, deciduous: petioles about 18 lines long, incrassate at each end; leaves coriaceous, entire, round-ovate to broadly elliptical, abruptly acuminate, 7-nerved, 5–7 inches long: racemes axillary and terminal, simple or dichotomous, exceeding petiole, 10–20-flowered; pedicels 8 lines long, recurved: flowers hermaphrodite: calyx in the bud linear, obtuse, entire, 9 lines long; in anthesis spathaceous, splitting into sepals at base only, reflexed: petals narrowly linear, tapering into a long claw, 10 lines long, the vexillar smaller: stamens united for a line or two in a sheath cleft to base; the fertile 3, equaling petals, anthers 2 lines long; staminodes intermediate with the fertile, half-connate, barbate within: pistil sigmoid, nearly equaling stamens; ovary pubescent in two lines, long-stipitate, beaked with a short stout style; stigma oblique, oval, a line long; legume coriaceous, flat, linear, 8–9 inches long, 9 lines broad: seeds 9–12, oval, flat.—A tree 12–15 feet high with roseate flowers. River banks, Pansamalá and Sacolol, alt. 37–3800 feet. June, 1885. (Ex. Pl. Guat. etc. 681.)

Anneslia Quetzal. (*Calliandra series Racemosae* Benth. in Trans. Linn. Soc. xxx. 550.)—Glabrous, glaucescent: stipules persistent, reniform, amplexicaul, erect, cartilaginous, rubescent-pallid, flabellate-veined, 9–18 lines broad, three-fourths as long: petioles 12–18 lines long: pinnæ 1–3-jugate, 4–6 inches long: leaflets 6–8-jugate, obliquely oblong or oval, base dimidiate-cordate, dark-green above, pale beneath, 12–18 lines long, a half to two-thirds as broad, lower pairs reduced: odd leaflet sessile, linear-lanceolate, 5–7 lines long, pallid, deciduous: peduncles 3–5 from upper axils, or shorter and subverticillate in a terminal [illegible] sessile raceme half a foot or more long: pedicels of 5–8 flowered umbels 2–3 lines long: calyx equaling pedicels, obscurely toothed: corolla 6–7 lines long, splitting at length nearly to base into lanceolate striate petals: stamens 60–70, connate for half the length of petals, 2–2½ inches long, half an inch shorter than style, white: anthers glandulous: legume flat, narrowly oblanceolate, about 4 inches long by 8 lines broad: valves coriaceous, glabrous, margins much thickened.—The large leaflets with a small odd one resemble those of several [illegible] but the inflorescence is that of [illegible] M[illegible] [illegible] Bentham, collected by Mr. V. [illegible], and the Mexican [illegible] F[illegible]. The remarkable stipules seem to be unmatched by those of any one other species. [illegible] Benth.—Santa Rosa, Dept. Baja Verapaz, alt. 5[illegible] feet. July, 1887. (Ex. Pl. Guat. etc. 1324.)

Triolena paleolata.—Stem [illegible] ascending, nearly simple, [illegible] with [illegible] hairs, as are the petioles, nerves and margins of leaves, articulations of pedicels, and [illegible] the calyces: leaves membranaceous, glabrous, pale beneath, [illegible]-lanceolate or lanceolate, 3–5-nerved from the small cordate base, triplinerved [illegible] each pair 4–6 inches long, a third as broad, petioles 1–2 inches long: [illegible] racemes [illegible] in fruit 1–2 inches long and about equaling peduncle: pedicels [illegible] calyx [illegible] equaling [illegible] petals 5 lines long, 3 lines broad, pink: appendages of greater stamens 2–3, clavellate-tipped, one-third longer than the uniporose anthers: capsule shortly obpyramidal, acutely triquetrous, 3 lines broad; seeds obconical, muriculate, pale with a red aril.—Damp rocks in the Pansamalá forests, alt., 3,800 feet, Aug., 1886. (Ex. Pl. Guat. cit. 726.)

Myriocarpa heterostachya. (*M. heterospicata*, BOT. GAZETTE, xii. 133.)—Monœcious and diœcious.—More recent specimens exhibit male and female spikes borne on distinct plants, as well as in distinct axils of the same plant.—Forests of Pansamalá, alt. 4,000 feet, Jan., 1887. (Ex. Pl. Guat. cit. 366.) The opportunity is seized to correct also the hybrid name first given.

Baltimore, Md.

Uncinula polychæta B. & C.

S. M. TRACY AND B. T. GALLOWAY.

Although this species has been known for more than ten years, it is believed that an attempt to reconcile the differences in published descriptions, with the addition of such facts as have been noted in a recent examination of fresh specimens collected on Sand creek, five miles east of Starkville, Miss., will be of interest to mycologists.

The most important bibliography of the species is here given. The earliest published description is by Berkeley and Curtiss, in *Grevillea*, vol. iv, p. 159, 1875–76, as follows: "*Uncinula pleochæta*. Perithecia scattered, appendages about 28, 1½ times longer than the diameter of the perithecium, hyaline. On leaves of Celtis occidentalis. Carolina. No. 5619." In Saccardo's *Sylloge Fungorum*, vol. i, p. 9, occurs the following (translation): "*Pleochæta*. Saccardo and Speggazzini. Michel. ii, p. 373. Perithecia imbedded in the mycelium, globose-lenticular, without aperture, texture subcoriaceous, parenchymatous, appendages very numerous, radiating, clavate, straight, simple, forming a hyaline band. Asci clavate, two-spored, spores rarely oval, without septa, sub-hyaline. Appendages very close together, straight, subhyaline at the base, asci smooth, etc. Separated from Erysiphe and Uncinula. *P. Curtisii*. Sacc. and Spez. Fung. Arg. Pug. ii, p. 44. *Erysiphe* and *Uncinula polychæta* Berkeley and Curtis, Grev. 1876, p. 159. *Uncinula Lynckii*

Spez. Fung. Arg. Pug. ii, p. 17, no. 54. Mycelium hypophyllous in orbicular whitish spots, perithecia scattered, appendages (about 28) half the diameter of the perithecia, hyaline; asci nodulose at the base, 80–90 × 25–30 µ, two-spored, spores nearly oval 25 × 17 µ, hyaline. Occurring on leaves of Celtis Talœ and C. occidentalis from Buenos Ayres. April, 1880. (Spez.) Alabama and Carolina. (Curtis.)"

M. C. Cooke, in "Notes on Perisporiaceæ of Saccardo's Sylloge Fungorum," published in *Grevillea*, xi, 1882, p. 35,

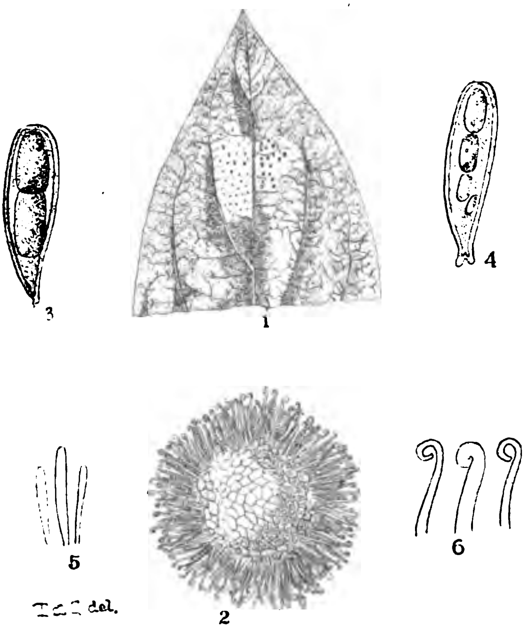

Fig. 1. Part of leaf, showing spot of *U. polychæta* B. & C. 2. Perithecium. 3. Two spored ascus—common form. 4. Four-spored ascus. 5. Clavate appendages from immature perithecium. 6. Curled tips of appendages from mature perithecium.

takes issue with Saccardo on the formation of the new genus *Pleochæta*, and insists that *P. Curtisii* Sacc. and Spez. is "a true Uncinula, with numerous appendages curled at the tips, just as in U. adunca, except that they are thickened upwards so as to be clavate;" and therefore it ought not to be adopted "as the type of a genus with straight appendages."

The *Journal of Mycology*, 1886, p. 43, says:

"*Uncinula polychæta* B. & C.—In the description of this species, published in *Grevillea*, vol. iv, p. 159, and in Saccardo's *Sylloge*, vol. i, the number of appendages is said to be "about 28," and the number of asci is not stated. In a recent examination of South American specimens from Prof. Spegazzini, I found a perithecium (the only *mature* one examined) containing 50 two-spored asci, and surrounded by over 200 appendages, 114–120 × 6–7 μ, hyaline, continuous, with attenuated, involute tips. Perithecia 225–230 μ in diameter.

"The foregoing notes are also applicable to specimens of *Uncinula polychæta* B. & C. in Ravenel's *Fungi Caroliniani*. The species is remarkable for its numerous asci and appendages, but it seems unnecessary, on this account, to make it the type of a new genus. Possibly, the statement that the number of appendages is 'about 28' is a typographical error for 'about 228,' which would be nearer the actual number."

In his *Additamenta*, published in 1886, Saccardo, however, still adheres to his original name of *Pleochæta Curtisii* Sacc. and Spez., even in a description apparently re-written from that in the *Journal of Mycology*, as follows: "Perithecia 225–230 μ in diameter, appendages numerous, about 200, hyaline, continuous, apex attenuated, incurved, asci about 50, two-spored."

In the specimens before us from Mississippi and Carolina, the mycelium is hypophyllous, in irregular whitish spots, as shown in fig. 1. Usually, but one such spot occurs on a leaf, and the mycelium is by no means abundant. The perithecia, which are irregularly scattered over the mycelium, are much larger than in any other American Uncinula, fresh specimens, collected in November, measuring 275–280 μ in diameter. U. spiralis is usually 85–100 μ, and U. circinatæ sometimes reaches 175 μ. Older specimens of U. polychæta measured 250–275 μ. The appendages vary from 250 to 300 or more, Berkeley and Curtis' "about 28" probably being a misprint for "about 280." On immature perithecia the appendages are all clavate, as described by Saccardo, but on mature specimens they become longer, 122–150 μ; the clavate form gradually merges itself into the coiled attenuate tips shown in fig. 6. Our material was abundant, and we found this change in form exhibited on every leaf examined. The "appendages clavate" of Saccardo and the "appendages curled at the tips" of Cooke are entirely harmonized by this knowledge.

The asci are broadly clavate, sometimes nodulose at the base, wall rather thick, quite regular in shape, and uniform in size, hyaline: from 50 to 62 in each perithecium. Spores usually two, oval, sub-hyaline, nearly filling the ascus. Sometimes three or even four spores are found in an ascus. When three occur in an ascus two are of nearly the usual size and the third quite small, and when four occur all are small.

Department of Agriculture, Washington, D. C.

BRIEFER ARTICLES.

Plan of a botanical laboratory—In the GAZETTE for November, 1887, Miss Lillie J. Martin published a plan of a botanical laboratory, which I

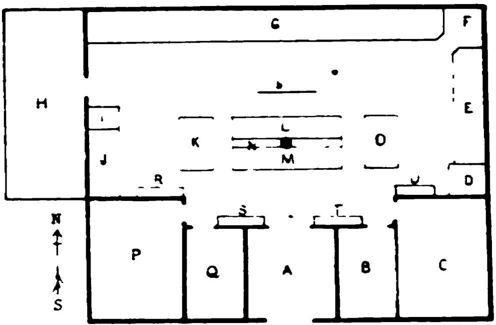

Fig I

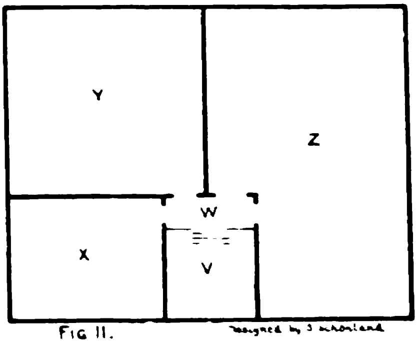

Fig II.

Designed by S. Schonland.

Size 50 x 40 ft Fig I ground floor, *A*, entrance hall, with stairway; *B*, dark room; *b*, blackboard; *C*, physiological laboratory; *D*, hood; *E*, tables for three advanced students; *F*, writing-desk; *G*, tables for twelve elementary pupils (there is room also for a second row); *H*, green-house; *I*, oven; *J* sink; *K*, table for general use; *L*, for large bottles with spirit, distilled water, embedding apparatus, etc.; *M*, table for chemical work; *N*, racks for reagents; *O*, table for microtomes; *P*, professor's room; *Q*, room for chemical balance and other delicate instruments; *R*, *S*, *T*, *U*, cases.

Fig II second floor, *V*, stairway; *W*, landing; *X*, library and reading-room; *Y*, lecture-room, with cases for diagrams, etc.; *Z*, large room in which models, dried specimens and specimens in spirit are kept. This room may be provided with a gallery.

fear will not be found acceptable by a great many botanists. I shall not criticise it in detail, but I may be allowed to state that the most eminent teachers of botany insist on having their laboratories conform to the following principles:

1. The laboratory should not be used as a lecture-room. Only occasional help by drawing on a blackboard should be given to the students, whereas systematic teaching is to be done in a room specially fitted for the purpose.
2. Models, dried specimens and specimens in spirit should be kept in a separate room, from which they can easily be taken into the lecture-room.
3. Only a few important text-books should be admitted to the laboratory. All other books and periodicals may be consulted in the library.
4. Chemical work should not be done on the same tables on which microscopical work is carried on. Whenever fumes dangerous to microscopes are given off in a chemical process a good hood is necessary.

In order to meet all these requirements I submit another plan. I have not indicated any windows, but have not left them out of account in my calculations. In the laboratory they ought to be as large and numerous as possible, but the exact position of them here and in all other rooms ought to be arranged with an architect, though not entirely left to him. At *R*, *S*, *T*, *U*, spaces are left for cases to hold material for cutting, bottles, mortars, funnels, etc. In the middle of the laboratory an iron column is to support the ceiling. The doors are indicated on the drawing, which will make the general arrangement of a laboratory as I should like to have it much clearer than I could make it by words. I refrain from going into details, as I shall have an opportunity of doing so in a future paper for the GAZETTE on the Oxford laboratory To prevent misunderstanding, however, I have to add that the plan of the Oxford laboratory is entirely different from the one I have designed.—SELMAR SCHÖNLAND, *Botanic Garden, Oxford.*

Effect of the wind on bees and flowers.—It must be a matter of common observation that the wind has an influence on the flight of insects and birds. While in continued flight they seem to have little difficulty in moving with the wind, in rising and lighting they use their wings with more precision when their faces are turned against it.[1] Thus, if a bee comes with the wind, it turns when it visits a plant and lights on the leeward side. If it is visiting flowers regularly, it moves against the wind, since it can rise and light more easily by so doing.

A simple effect of the wind on flowers is that it carries the odors so that they are most readily perceived on the side toward which it blows.

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[1] In Florida I saw many buzzards and vultures lighting with their faces to the wind When disturbed, they rose against the wind and swung around and lighted with their faces toward it. If one passed a few feet beyond where he wished to light, he would make a circle of 200 yards rather than turn with his back to the wind.

Then the wind catches in the leaves and flowers and bends the stems and branches, so that the flowers are most conspicuous on the same side. I have seen the heads of Helianthus grosse-serratus turned to the northeast by a southwest wind, and the bees were flying southwest, and thus approached the heads in front. But the flower-stalks often whip about, making it hard for an insect to light. It must be tantalizing to a bee for the head to fly up and leave her suspended in mid-air.

In Physostegia the flowers are nearly sessile, so that they are not easily shaken by the wind, and when turned to any position remain in it. Prof. W. W. Bailey says:[2] "The flowers are made to assume their definite position by friction of the pedicels against the subtending bracts. Remove the bracts and they at once fall limp. This was shown me by Prof. Goodale in 1879." With the breath one can easily blow the flowers to the opposite side of the spike.

Prof. Coulter[3] has observed how the movement of the flowers is useful in bad weather by turning their mouths from a driving rain, but I think it is also advantageous in fair weather in adaptation to the flight of insects.

In September, 1886, I found several hundred stalks of Physostegia Virginiana arranged in a long patch along the railroad. The southwest wind was blowing up the road, and the flowers were all turned away from the wind, so that they looked to the northeast. As I walked through the patch from the southwest, I passed nineteen humble-bees, Bombus Pennsylvanicus[4] (females and workers), all going against the wind, except two, which did not visit the flowers regularly but flew away to the northeast. Returning, I overtook the bees going against the wind, but passed none going with it. Keeping their faces to the wind, they would move from side to side, or even let themselves back to a spike they were about to leave behind. It was interesting to observe that, while the wind required the bees to face it, it compensated for the disadvantage by carrying the odors to them and by turning the flowers so that they were more easily seen and visited by them.—CHARLES ROBERTSON, *Carlinville, Ill.*

Conditions of Assimilation.[5]—In this paper Dr. Pringsheim notes the limitations of the prevalent method of gas analysis, and has striven by direct observation of the protoplasm to determine the seat and relations of the various functions. It seemed likely that the observation of protoplasmic movements in varying conditions of light and darkness, and in partial or total removal of oxygen, would afford a suitable starting point for his researches. Previous experiments had forcibly suggested that observed differences in the assimilative energy did not in any way depend on differences in the number of chlorophyll-bodies, or on the abundance of chlorophyll within these, but on the oxygen respiration of the protoplasm. This point Pringsheim sought further to investigate.

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[2] BOT. GAZ. vii, 122

[3] BOT. GAZETTE. vii, 111.

[4] The flowers are also visited by Apathus elatus (frequent) and Colias Philodice (once).

[5] Dr N. Pringsheim has communicated to the Prussian Academy of Sciences a preliminary account of his researches on the dependence of assimilation in green cells on the presence of oxygen and on the locality where the oxygen formed in assimilation actually originates These researches are so important that we present the following abstract by Prof. A. W. Bennett, from the *Jour. Roy. Mic. Soc., Dec.*, 1887, p. 992 --[EDS.

It has been long known that the green cells can break up CO_2 in the absence of oxygen, where the CO_2 is mixed with some innocuous ɐgs. It is also known that protoplasmic movement is dependent on the presence of oxygen. If this be so, the protoplasmic movement in a green assimilating cell, in a medium free from oxygen, should not come to a stand-still as long as it is illuminated, and the conditions of carbonic dioxide analysis fulfilled.' With these facts in view, Pringsheim tried by experiment to answer the question whether a plant normally assimilating would cease to assimilate, without any alteration of its chlorophyll relations, if it were deprived, even for a short time, of the oxygen which is essential for respiration and plasmic movement, and whether it would recommence to assimilate whenever fresh oxygen was supplied. His experiments answered this in the affirmative.

The naked terminal cells of Chara leaves were placed in suspended drops in a microscopic gas chamber; oxygen was, as far as possible, excluded, a continuous stream of CO_2 and hydrogen passed through, and the amount of light caused to vary. In darkness the rotation of the protoplasm gradually ceases, the length of time before stoppage varying with the degree to which oxygen is successfully excluded, with the specific nature of the cell, and with the mass of protoplasm. The final result is a state of complete "asphyxia," when the cell is dead, though still normal morphologically. If the cells be taken just before asphyxia, just when the protoplasm is ceasing to move at all, it will be found that they are no longer able to assimilate. They are still quite normal; but if now placed in an illuminated chamber, and supplied as before with carbonic acid, the rotation will not return. A little free oxygen restores the original state; but without this, in spite of the presence of light, chlorophyll and CO_2, no oxygen is formed. This state Pringsheim calls "inanition" or "Ernährungs-ohnmacht." What has been noted in regard to its occurrence goes to show the dependence of assimilation on the absorption of oxygen.

But it is also a fact that the same phenomena of inanition occur when cells in similar circumstances are kept continuously in the light. Repeating the above experiment with continuous illumination instead of darkness, Pringsheim again observed the stoppage of rotation, and with it the cessation of the liberation of oxygen. The absence of free oxygen is again the condition of the cessation of function; if a small quantity be introduced the life revives, at least if inanition has not gone too far.

How is this to be explained in terms of the generally accepted theory of assimilation? *If the disruption of carbonic dioxide within the cell furnishes oxygen directly*, how can any assimilating cell suffer from want of oxygen? Pringsheim does not admit the usual assumption italicized above. His opinion is that the analysis of the CO_2 in assimilation does *not* directly furnish oxygen, but that some other substance is formed, which, passing diosmotically to the surface, breaks up and liberates free oxygen. He criticises the usual arguments based on the results of gas analysis. What the substance is which forms oxygen at the surface he is not prepared to state.

If this be so, the breaking up of CO_2 and the liberation of O are two processes, distinct both in space and time, the one occurring within the cell, the other at its surface. This view is supported by reference to the peculiar liberation of oxygen exhibited in darkness by both green and unpigmented cells toward death. The bacterium-method proves this fact incontestably. This liberation of oxygen in darkness, quite independent of contemporaneous assimilation, may be termed "intramolecular liberation of oxygen," and, according to Pringsheim, the normal liberation is an essentially similar process, resulting from the disruption of an exosmosing substance.

He advances other arguments to show that we are not warranted in concluding, as has hitherto been done, that the presence of light, chlorophyll and CO_2 exhausts the conditions of assimilation, and that in estimating its amount no other factors but light-energy and the absorption of light by the chlorophyll have to be taken into account. Assimilation is, on the contrary, a physiological function of the protoplasm, and, like movement, depends on the presence of free oxygen. Physiologists will look with interest for Pringsheim's detailed account of his investigations on this important subject.

The proposed Botanical Exchange Club.—The committee appointed by the Botanical Club of the A. A. A. S. at the New York meeting to act for the club in the formation of a Botanical Exchange, after considerable correspondence and the consultation of the rules and regulations of similar organizations abroad, is now in a position to submit to the members of the club certain tentative propositions, on which individual opinion is solicited.

The regulations of the Botanical Exchange Club of the British Isles, published in pamphlet form at Manchester in 1886, seem applicable to our needs, with certain necessary modifications. In order to bring these before the botanists of the country, a synopsis of them is here presented, arranged with reference to America instead of Great Britain.

1. The object of the club will be to facilitate the exchange of herbarium specimens of American plants, specially of rare species and varieties. The conditions of membership to be that each member shall furnish a parcel of specimens annually, and pay a yearly subscription of a

sum not to exceed ($3.00) three dollars, to meet the expenses. Members will be entitled to a share in the distribution of specimens made in the early part of the year following that in which their subscriptions and parcels were sent.

2. The annual list of desiderata will be made up by combining those of all the members of the club, and then be printed and sent to every member. Each individual list must not exceed a certain number of species annually, for if unlimited the printed list would be too voluminous for practical use with our very extensive flora, at any rate for a number of years. The determination of the annual number of desiderata will require further cônsideration.

3. Some member will have to act as distributor each year, either voluntarily, or. if no one is found willing to act without recompense, provision will have to be made for employing a distributor at a small salary. The plan as here outlined would not necessitate very much work, and it certainly would be of an interesting nature. The committee will be pleased to receive communications relative to this.[1]

4 It will be necessary to adopt some one check-list as the official one of the club, and this must either be used in sending lists of desiderata by marking the species desired, or if a reliable numbered check list can be procured, the list of numbers might be sent. This is also a question for further consideration. It has been the experience of the British Club that manuscript lists of desiderata should not be received.

5. Each species should be represented by a number of specimens to be determined when the probable number of members shall be ascertained. It is not necessary to emphasize at this time the necessity for complete and satisfactory specimens being furnished, with appropriate labels.

The British Club in 1886 had a membership of fifty-eight, and has been in successful operation for a number of years. It would seem certain that at least an equal number of American botanists would consider it advantageous to join a similar organization.

Suggestions regarding the matter here presented and applications for membership should be sent to the chairman of the committee, Dr. George Vasey, U. S. Department of Agriculture, Washington, D. C.

THE COMMITTEE.

Phacelia heterosperma.—Annual, a foot or less high, with erect branches, glandular and viscid, the foliage and inflorescence with sparse short and viscid hairs: leaves few on short petioles, ovate, an inch long, with a few coarse angular teeth, or the basal ones nearly entire: flowers in strict spiciform racemes, at length elongated and loose: corolla companulate, 3-4 lines high, little exceeding the spatulate sepals, light purple with yellowish base: the unequal filaments and short cleft style included: capsule oblong, 3 lines high, exceeded by the sepals; seeds numerous (40-50), light brown, deeply pitted and variously angled or rounded. Of the *Eutoca* group.—In wet sand, banks of Rock creek, borders of the Mojave desert, Los Angeles Co., Calif., June, 1887.—SAM'L B. PARISH, *San Bernardino, Calif.*

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[1] Dr. Vasey writes that Commissioner Colman has consented, if it be deemed advisable, that the Botanical Division of the Department of Agriculture take charge of the exchanges and distribution without expense to the members of the club. N. L. B.

EDITORIAL.

THE DEATH of Dr. Asa Gray removes from American botany one who can have no successor. His work may be continued, but his commanding position can not be attained by any other. The circumstances which gave him such a grasp upon men and materials will not be repeated. The greatest name in American botany is the unanimous verdict of his countrymen. But his most enduring monument is not this unanimous acknowledgment of his greatness as a botanist, but the loving remembrance of the kindly, helpful man, which is cherished in the hearts of more than one generation of botanists, none of whom he ever turned away unanswered, all of whom he considered as friends that must be helped. Two years ago the GAZETTE published, with his sanction and help, a biographical sketch; and it but remains now for us to pay our tribute of love and respect to one who has been taken away, full of years and honor, but still in the midst of his work. The loss seems an irreparable one, but his name will always be a guide and incentive to every American botanist

THE ARTICLE by Dr. Minot in a recent number of *Science* regarding the unsuitableness of American microscopes for the use of biologists has provoked comment from nearly every American journal dealing wholly or in part with biology, and the verdict appears to be that some of the writer's points were well taken, although the statements may have been stronger than the facts will warrant. The rapid increase in number and size of biological laboratories brings about an increasing demand for a low-priced instrument adapted to certain kinds of work. This demand is met by German manufacturers, but is to a certain extent ignored by American manufacturers. The result is that probably half of the instruments now bought for biological purposes come from abroad, and the number would doubtless be greater but for the trouble and delay of importing. The subject is one that has often been discussed, but the present agitation is more general than at any previous time, and promises to be more fruitful, as it has aroused the makers to a show of defense. The American manufacturer takes pride in the handsome instrument which he turns out, and the only influence that is likely to be strong enough to develop a permanent interest in the small plain instrument the biologist is asking for is a financial one. That there is an inclination to meet the rising demand is evident from the circular of inquiry sent out by Queen & Co. last year, from the construction of the "Harvard" stand by Bausch & Lomb Optical Co., which embraces some features of the foreign models, from the similar stand just put in the market by Bulloch, and from the tone of the replies already made to Dr. Minot's article. The old prejudice against American instruments, because American, has nearly passed away, and the investigator is now likely to buy where he can best and most easily meet his needs. On the other hand, if the instrument-maker will lay aside his prejudices against a plain instrument of superior workmanship, there will not long be grounds for accusation and controversy.

OPEN LETTERS.

Mutilation of flowers by insects.

On page 111, 1887, of the GAZETTE I suggested that botanists note all cases in which insects mutilate flowers for the purpose of securing the nectar: and that the insects be captured, and their scientific names be published with such notes. Professional duties have made it impossible for me to give much time to this class of observations, but have the following notes which may be of some value. I found that a majority of the corollas of a large number of plants (examined in several localities) of *Physostegia Virginiana* and *Mertensia Virginica* were slitted as described in the GAZETTE for October, 1886 and May, 1887. The only insect which I found doing this work was *Bombus Pennsylvanicus*. For nearly two months, during the past summer, I had under observation two large vines of two species of honeysuckle. In the first, the common woodbine, the corolla is deeply cleft, with the lips well turned back. This plant is deliciously fragrant, and, to my surprise, the only insects which visited it belong to the genus Halictus, apparently all the same species. All entered at the open mouth of the corolla. The flowers are proterandrous. In the second, the trumpet or coral honey-suckle, the mouth of the corolla is small and the short divisions not reflected. It is also proterandrous. This species was abundantly visited by the leaf-cutter or upholster bee (Megachile brevis), and one or more species of Halictus.[1] The leaf-cutter bee never enters the mouth of the corolla, but goes directly to the base, and shears out a round piece, usually near one-eighth inch in diameter; through this it extracts the sweets. It is sometimes necessary to make two or three openings before it gets to the right place. This operation is done as easily and quickly as one could do it with sharp scissors. In the majority of instances the piece cut out is allowed to hang by a little hinge at one side. Through this circular opening the Halictus enters and makes a more thorough search for the remaining honey.

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[1] These small insects are commonly known as "sweat bees," from their habit of alighting on one's person while sweating freely and sucking up the perspiration. Mr. C. M. Weed, of the Ill State Laboratory, kindly identified the insects for me

In case the flower has not been visited by a Megachile the Halictus goes to the mouth of the corolla and enters in the usual way; but it usually alights on the base first and hunts for the artificial opening.

Mt. Carmel, Ill. J. SCHENCK.

An acknowledgment.

In the correcting of the proof of the paper on the ostrich fern, noticed in the GAZETTE for December, a paragraph stating under what conditions the investigations were made was inadvertently omitted. The work was done under the supervision of Professor V. M. Spalding, of the University of Michigan, to whom the author begs to offer this somewhat tardy expression of his thanks for the valuable assistance and encouragement received from him during the pursuance of the work.

Berlin, Germany. DOUGLAS H. CAMPBELL.

CURRENT LITERATURE.

Flowers and fruit of Sparganium and Typha.[1]

In this monograph Dr. Dietz has given the results of a comparative study of the development of the floral and fruit structures of Sparganium and Typha. It is a good model of those studies which are necessary before botanists can speak with any definiteness upon the relationships of plants; studies which should be greatly multiplied, and which furnish a vast and useful field of labor for our ever increasing army of botanists. Taking a group of doubtful relationships, the author has laid the foundation for a rational discussion of the subject, which he promises at some subsequent time. The vegetative structures are mostly alike, but the reproductive organs show notable differences. A radical difference occurs in the positions of the flowers themselves, those of Sparganium occurring upon secondary and tertiary axes, while those of Typha are upon primary and secondary axes. Every detail in the development of the floral parts is described and figured with that minuteness that seems to leave none of the anatomical details unrecorded. The greatest differences are found in the structures of the pistil, the most apparent of which is its bicarpellary character in Sparganium, and monocarpellary character in Typha. The formation of the integuments of the seed also differs widely. In conclusion, the author considers that, while there are enough characters in common to justify retaining these two genera in one order for the present, the differences are sufficient to indicate that there may be ordinal characters. This structural study shows that Sparganium is nearest to the Pandaneæ, while Typha shows relationships to the Aroideæ.

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[1] DIETZ, DR. SANDOR —Ueber die Entwickelung der Bluthe und Frucht von Sparganium Tourn. und Typha Tourn. (Bibliotheca botanica, heft 5.) 60 pp., 3 plates. 4to. Cassel Theodor Fischer, 1887.—8 marks.

Lessons in botany.[1]

Dr. Gray has been preëminently the teacher of botany in this country for half a century: not only in marshaling our hosts of North American plants into an orderly array, but, also, in imparting, by means of his text-books, the general principles of the science. No text-book has been more widely used than the one of which this is a revision; and nothing could be more appropriate than for the author himself to give a final revision, which has been long demanded by our rapid advance in knowledge. There can be no doubt that this is the best book for its purpose that we now have. Choosing for a title that of his first text-book, published over fifty years ago, the author presents, in that clear and simple style of which he is so great a master, the elements of botany which he considers are essential for beginners to know. In the preface he wisely calls attention to the fact that even this book should be considered more of a reference book than anything else, and that its technical names mean nothing unless applied. In fact, its legitimate use seems to be that of an extended and illustrated glossary, to be elaborated by the teacher and applied in the laboratory. If so useful a book is to be criticised, we would say that, although it is a vast improvement upon the edition it is meant to replace, there might have been some additional improvements that even conservatism will allow to the "cryptogamically-minded." The perpetuation of the word "nucleus" to express what we now understand by "nucellus" is a case in point, and must lead to a confusion of terms that is not helpful, to say the least. Many of the figures have served their day and generation, and might well have been replaced by others, not because the latter would have looked better, but because they would have represented facts (*e. g.*, those representing the anatomical elements of the fibrovascular system, pp. 133–135). The figure of Oscillaria, p. 149, could surely have been bettered. On page 101, fig. 295 still conveys its old impression that pollen sacs are made by rolling up the leaf edges, an impression which a sentence added to the foot-note would have corrected. A remarkable slip is found on p. 104, where it is said that the pollen of pine "consists of three cells, of which the middle one is large, wholly empty, and light." Undoubtedly, the use of old figures is largely to be ascribed to the publishers. Although more concession to the results of modern botanical work might have been expected, the author may have been wisely conservative, and his justly great name insures a book that can be trusted.

Poisonous plants.

At the time the editorial was written which appeared in this journal a few months since on plants considered harmless by most persons, but thought to be poisonous by some, it was not known to the editors that a book covering about the ground there suggested had just been issued.

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[1] GRAY, ASA.—The elements of botany, for beginners and for schools. (Lessons in botany, revised edition.) 226 pp., 589 figs., small 8vo. New York and Chicago: Ivison, Blakeman & Co., 1887.—$1.00.

The work[3] has since been sent for review, and can be commended as a carefully prepared account of the action of irritants upon the skin, especially those directly due to or derived from plants—such plants being generally spoken of as poisonous. Dr. White, the author, is professor of dermatology in Harvard University, and speaks with authority about the forms and degrees of inflammation and the subsequent development of the affection caused by each plant of which he writes. He has also called to his assistance a number of eminent authorities in botany, zoölogy, etc.

About fifty pages of the work are occupied with an account of irritants other than vegetable, but it is of the latter only that we shall now speak. Eighty-six genera of plants, mostly found in the United States, with one or more species each, are put into the list of "poisonous." The virulent kinds of Rhus naturally take the lead, and the series shades off into such apparently innocent but quasi-harmful plants as the delicate wind-flower, the earliest of the Anemones.

Forty pages are devoted to rhus poisoning—too much to be even summarized in this place. We turn with interest to the treatment of its etiology, and are somewhat disappointed to find that the latest reference is to work done in 1865. At that time Prof. Maisch, of Philadelphia, decided that the poisonous properties reside in a volatile acid which he called toxicodendric acid. No reference is made to Dr. Burrill's statement that the action is due to microbes, which he described and named. The bacterial theory has received some credence, even from careful medical writers (*e. g.*, Dr. Gradle in "Germ Theory of Disease," 1883), and a description of the microbe is included in systematic works (*e. g.*, Grove's "Bacteria and Yeast Fungi," 1884), so that some notice of it would have been in place.

Many of the plants put into the indicated list, one might possibly say the majority, are usually looked upon as harmless, and the reader is treated to a succession of surprises quite as disagreeable in their way as if he were to discover that his respected, although it may be humble, acquaintances were being accused of petty misdemeanors. Thus, the list includes, to cite at random, arnica, beggar-ticks, fleabane, burdock, ox-eye daisy, mayweed, golden-rod and cocklebur. The way in which the poisonous effects are produced are as diverse as the plants which produce them. In some cases successful remedial agents are known.

As this is the first book of the kind, there is necessarily much omitted; for instance, no mention is made of the strong vesicating action of the juice of Euphorbia marginata, a fact well known to most persons who have had the plant in their gardens. The experience of nearly every one will probably suggest some items of additional information, and the author will doubtless be pleased to receive data of authentic nature from users of the work.

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[3] WHITE, DR. JAMES C.—Dermatitis Venenata, an account of the action of external irritants upon the skin. 216 pp., 8vo. Boston: Cupples & Hurd, 1887.

A monograph on Stigmaria.[4]

Professor Williamson has done more, probably, than any other individual towards perfecting our knowledge of the structure and affinities of the plants of the coal-measures. Entering the field of palæontological science in 1833 as a contributor to the "Fossil Flora of Great Britain," by Lindley & Hutton, almost every year since has witnessed the production from his pen of papers of more or less extent, describing in detail the histology and relationships of carboniferous plants. The last is the elaborate and beautiful memoir before us.

Stigmaria ficoides is one of the most abundant and well-known plants of the carboniferous age. It is most frequently met with, however, in the form of inorganic casts of the scarred exterior or of the fistular medullary interior. As these casts were the only conditions under which it was known for a long time, the histology, and consequently the affinities, long remained in question. During the last half-century, however, specimens have been obtained from various localities in which the structure has been more or less clearly preserved, and through a study of these considerable light has been thrown upon the affinities of these curious plants.

Professor Williamson has spent the past twenty years in collecting the material upon which present results are based, and his is undoubtedly the most complete collection extant. These specimens, with the structure exquisitely preserved, come mostly from the districts around Oldham and Halifax, occurring in calcareous nodules imbedded in coal seams.

The results of a study of the histological elements in these specimens, briefly stated, are as follows: The medulla was composed exclusively of parenchymatous tissue, and early, by absorption or decay, became hollow. Into this fistular medullary cavity stigmarian or other rootlets penetrated, sometimes to the number of half a dozen, thus causing great complication. These specimens, to the casual observer, would appear to be traversed by fibro-vascular bundles, and by a study of such specimens several observers were led into error.

Surrounding the medulla was a vascular or xylem cylinder composed of transversely barred vessels or tracheids. These tracheids, arranged in bundles, did not preserve a longitudinally straight, but an undulating course through the stem, the undulating curves of one bundle being opposed to those of its neighbor on either side. "The result of the wavy undulations was that contiguous bundles alternately touched and separated from one another, inclosing, in the latter case, large, vertically elongated lenticular spaces, occupied by extensions of the medullary parenchyma which thus reached the bark. As the vascular cylinder grew exogenously each new superadded vessel followed exactly the undulating course of those upon which it rested."

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[4] WILLIAMSON, WILLIAM CRAWFORD.—A monograph on the morphology and histology of Stigmaria ficoides. (The Palæontographical Society, volume for 1886.) 62 pp., 15 plates. London, 1887.

The cortex consisted of three layers, which pass more or less gradually into each other. The outer is composed of parenchymatous cells, which are without special order of arrangement; the inner of a zone of cells arranged in radial parallel lines; while the middle is a transition with slight distinguishing characters, from the one to the other.

The origin of the root-bundles which run to the rootlets is as follows: Some of the vessels of the xylem cylinder, or usually, in the initial step, one vessel, instead of pursuing the undulating course, is deflected outward and forms the basis of one of these bundles. Other vessels are added to it from time to time, and it thus increases in diameter. Where these emerge from the bark a lenticular scar is produced, giving rise to the well-known stigmarian characters.

Without going further into a description of the histology, the conclusions of Professor Williamson may be summed up as follows: Stigmaria were *always* roots, and, moreover, were roots alike of Lepidodendra and Sigillariæ, which primeval Lycopodiaceæ were undoubtedly the remote ancestors of the modern Lycopodiaceæ. This view is strengthened by the analogy which is shown to exist between stigmarian roots and the roots of modern Lycopodiaceæ, particularly of Selaginella and Isoetes. The latter, like Stigmaria, has a fistular medullary cavity which is produced by the early absorption or non-development of the delicate parenchyma which ought to be present. The origin of the rootlets is also similar.

F. H. KNOWLTON.

Diseases of the grape.

Two important works on the diseases of the grape have recently appeared in France. A small work on the black-rot,[5] by MM. Viala and Ravaz, is a revised and somewhat enlarged edition of the treatise by the same authors which appeared a little over a year ago. A number of the figures in the present edition are new, and are especially clear illustrations of the botanical characters of the fungi they represent. The first sixty pages are devoted to the discussion of the black rot, with a comparative study of other forms of grape-rot which have not always been clearly distinguished from it. Considerable space is devoted to pointing out the distinctions between black rot and anthracnose, which "have been and are yet confounded with each other in publications."

The first illustrated description of anthracnose published in this country was that which appeared in Bulletin 2 of the botanical division of the United States Department of Agriculture, published last year under the direction of the commissioner of agriculture. In this publication the distinctive characters between the black rot and the rot of anthracnose were clearly pointed out. There has doubtless been some confusion in this country in the use of popular terms for these diseases; but the term "bird's-eye-rot" has been applied to anthracnose on the berry, and may well be generally adopted, as it is peculiarly descriptive and certainly would never be applied to any other variety of grape-rot.

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[5] VIALA, PIERRE, and RAVAZ, L.—Le Black Rot et le Coniothyrium diplodiella. (Second edition.) 88 pp., 1 colored plate and 15 wood-cuts, small 8vo. Montpellier and Paris. 1888.

The work concludes with a bibliography of the subject, and although a number of American authors are cited the greater number of papers appear to have originated in France. Some important observations made by Prof. Viala while in this country the past summer are included in the book. F. L. S.

The second of the works referred to is a much larger volume;[4] a larger volume in fact than most persons would suppose could be written in a concise and well digested form on the diseases of the grape. The treatise is written from a practical stand-point, the author, Dr. Viala, being professor of viticulture in the National Agricultural School of Montpellier, France.

Half of the volume is devoted to the two mildews, one growing upon the surface (Oïdium Tuckeri), and the other (Peronospora viticola) within the leaves and other parts of the host. There are forty-five pages on black rot (Physalospora Bidwellii), and as many on anthracnose (Sphaceloma ampelinum); while sixteen pages on melanose, a poorly recognized disease caused by Septoria ampelina, and the "American oidium," Uncinula spiralis, completes four-fifths of the volume. The remaining fifth of the volume enumerates 275 species of fungi which have been found growing upon the grape, with notes on a few of them, and gives brief descriptions of diseases not due to parasitic fungi. This long list of fungi is divisible into three categories, including 150 accidental, 100 saprophytic, and 25 parasitic species. It is the latter sort that more especially interest the cultivator and the economic botanist.

The half-dozen diseases which form the bulk of the volume are mostly of American origin, and all occur in the United States, unless it be the imperfectly known European oidium. The author's treatment is logical, concise and well-directed, and the illustrations ample and satisfactorily executed. It is to be hoped that before long similar works on the more important plant diseases will be written for this country.

An outline of the topics under black rot, although not the longest subject, will give an idea of the author's method. After a few words about the name, and a bibliography in which are the names of Andrew Fuller, Robert Buchanan, Bush and Meissner of Missouri, George Engelmann, Geo. Husmann, J. Strong, Wm. Trelease, J. B. Ellis, F. L. Scribner, and E. C. Bidwell, all American writers, a history of the disease in France and in America is given, followed by a description of the external characters by which it may be recognized. The part devoted to the botanical characters of the fungus shows the species to be very polymorphic. The indebtedness of the author to the studies of Prof. Scribner, of the United States Department of Agriculture (published in this journal for November, 1886, and elsewhere), is acknowledged, especially his indebtedness for the account and illustrations of the perithecia, which have, up to the present time, only been observed in this country. The subject is appropriately closed with full details of all effective means yet known for combating the disease.

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[4] VIALA, PIERRE.—Les Maladies de la Vigne, avec une étude des appareils de traitement par Paul Ferrouillat. (Second edition.) 462 pp., five colored plates and 200 wood-cuts. 8vo. Montpellier and Paris, 1887.

NOTES AND NEWS.

Miss Susan M. Hallowell, professor of botany at Wellesley College, is pursuing studies in the laboratory of Dr. Kny at Berlin.

Dr. J. H. Oyster, of Paola, Kansas, has published his new catalogue of North American plants. It contains 125 pages and an index of genera. The price is $1.25.

"**Timber**, and some of its diseases," is the subject of a series of illustrated papers by H. Marshall Ward in *Nature*, beginning with issue of December 22, 1887.

Marcus E. Jones gives a very interesting description of the flora of Utah, in a four-page pamphlet, said to be a reprint from Tullidge's magazine, *The Western Galaxy*, for March, 1888.

The volume on British Discomycetes by William Phillips, F. L. S., which was announced more than two years ago, has recently appeared as a number in the International Science series.

Edward L. Berthoud, a well known botanist and engineer of Colorado, is making a botanical excursion into Lower California, not only along the coast, but into the interior, from which we expect some interesting results.

A society for the promotion of the knowledge and cultivation of Cacti and other succulent plants has been established at Antwerp, under the title of "Vetplantenkring." Any one interested in the subject can address the secretary, Mr. T. Havermans, Rue Jésus, 46, Antwerp.

Dr. Anton de Bary, Professor of Botany in the University of Strassburg, died, after a brief illness, on the 20th day of January, in the fifty-seventh year of his age. The **Gazette** will publish next month a sketch of his life and personal traits from the pen of a former pupil, Dr. F. B. Power, of the University of Wisconsin.

Edward S. Burgess has published a little guide to the student in botany for his use in the Washington (D.C.) High School. It shows a commendable effort to pursue the study of botany in the right way, even in high schools, and probably pushes the subject as far as is consistent with the time and appliances at command.

Dr. Alexander Dickson, Professor of Botany in Edinburgh University, died December 30, being seized with a sudden illness while on the ice, engaged in his favorite pastime of "curling." He was 51 years of age. A biographical sketch in *Nature* (January 5) says that by his death the world loses one of its best morphologists.

NEW SPECIES of grasses are described by Dr. Geo. Vasey and Prof. F. L. Scribner in the *Bull. of Torr. Bot. Club* for January. They are a Muhlenbergia and a Sporobolus from Arizona, a Deyeuxia and a Bromus from Montana and the northwestern mountain region, two species of Poa and four of Alopecurus from Oregon and the northwest.

THE January number of the *Journal of Mycology* gives the usual variety of contents, but appears in a blank cover. There are 35 species added to the formerly printed list of the Ramulariæ and Cercosporæ of the United States, and 15 new species of *fungi imperfecti* are described. The February number will be delayed and issued with the number for March.

THE BOTANICAL SECTION of the biological society of Washington, at their first monthly meeting (January 4), presented the following programme: Recent progress in the study of the fresh-water algæ, E. S. Burgess; A case of sewer obstruction by tree roots, F. H. Knowlton; Some fungi of the arid regions, S. M. Tracy; Glœosporium of the wax bean and Asteroma of the rose, Miss E. A. Southworth.

A WINTER course of four lectures before the Amateur Botanical Club of Washington was as follows: Prof. Miles Rock on the Guatemala forests, Prof. J. W. Chickering on the flora of Alaska, Prof. Edw. S. Burgess on the fresh-water algæ of the District of Columbia, and Dr. George Vasey on some important medical plants. The club is in a prosperous condition, having forty members and a good attendance at its regular meetings.

AN ABSOLUTELY NEW VEGETABLE is a rare thing to chronicle in these days, but such a thing falls to the lot of the *Gardener's Chronicle* (January 7). It is a tuber developed by a Chinese Labiate, said to be a Stachys. The tubers are borne at the ends of underground branches exactly as in the potato, and are also marked by buds, or "eyes," at the nodes. The plant is said to be hardy, is of the easiest possible culture, and produces the tubers in great profusion.

THE NOMENCLATURE of Nymphæa is further considered by Mr. James Britten in *Journal of Botany* (January). Enlarging upon Mr. E. L. Greene's discovery (*Bull. Torr. Bot. Club*, Sept., 1887), he gives still more convincing proofs that our nomenclature of water-lilies must be changed. Nymphæa should be *Castalia* Salisb., and Nuphar is *Nymphæa* L. The results upon our American forms are as follows: Nymphaea odorata becomes *Castalia pudica* Salisb.; Nuphar advena becomes *Nymphæa advena* Soland., and so on.

GARDEN AND FOREST is the name of the new journal for which the name of "Sylva" was first proposed. The first number will be issued this month. The editor-in chief, Prof. C. S. Sargent, will be assisted by Dr. W. G. Farlow in the department of cryptogamic botany and plant diseases, Dr. A. S. Packard in entomology, and Mr. W. A. Stiles as managing editor. Many eminent writers have signified their willingness to contribute, and there is promise of an auspicious beginning. It is to be a weekly at four dollars a year.

THE INFLUENCE of forests upon rain-fall is a much-discussed question. Mr. Henry Gannett, in *Science* (January 6), treats this subject in a tabulated way, giving the rain-fall through a long series of years over the regions where one would expect a diminution from "deforesting." His conclusion is, "it seems idle to discuss further the influence of forests upon rain-fall from the economic point of view, as it is evidently too slight to be of the least practical importance. Man has not yet invented a method of controlling rain-fall."

FREDERICK BRENDEL has distributed a pamphlet of about ninety pages, entitled "Flora Peoriana." It is a careful and painstaking presentation of the observations of thirty-five years upon the vegetation of a small area in middle Illinois. It is intended to show how local floras should be treated to be useful to phytogeography; how notice should be taken of soil and climate, to understand the vegetation of a certain floral district. It is packed full of useful information, and would serve as a guide to similar observations elsewhere.

FORMATION of starch by plants has been the subject of experiments recently conducted by Professors Ivey and Gray at the School of Agriculture, Canterbury, New Zealand. Peas, beans and wheat were used, and up to date the following results have been obtained, as given in *Gardener's Chronicle* (January 7): "Starch is least plentiful in leaves collected in early morning, more plentiful in those collected late in the afternoon, but before evening. The degree of sunshine has a direct effect on the rate of starch-formation; in continuous cloudy weather starch is formed by plants but very slowly."

"CONTRIBUTIONS to the life-histories of plants" is the title of a paper distributed by Mr. Thomas Meehan, a reprint from the *Proc. Philad. Acad.* It consists of observations of various kinds upon various plants. Amphicarpæa monoica is observed to have apetalous flowers upon the climbing as well as the trailing stems; these flowers produce a third form of pod, and are fertilized from the petal-bearing flowers. Cephalanthus occidentalis is shown to be close-fertilized by the rapid development of the style sweeping the pollen out of the anthers, after the manner of the Compositæ. In Amorpha canescens it is observed that the vexillum is remarkably tardy in development, in fact attaining its size and attractiveness after fertilization has been effected. In Oxybaphus hirsutus, also, nothing suggests any arrangements for cross-fertilization.

PROFESSOR PIERRE VIALA sailed for Europe on December 3, after a stay of some months in this country. One of the objects of his mission was to see if there was any species of Vitis growing wild in the United States on soils corresponding to the calcareous (chalk) soils of central France. He traveled through the southern United States, making special study of grape culture in California and Missouri. In Texas he gathered some interesting facts about the native species of Vitis, one species of which is likely to prove useful in France. Some forms of viticolous fungi were recognized not before recorded for the United States. He returned feeling that he had been most happily successful in the accomplishment of the purposes of his visit. His report will probably appear in France and in this country at about the same date, and will be a work of special interest to American viticulturists.

ERRATA.—On page 5, foot-note. for "1877" read 1887. On page 9, third and fifth lines from bottom: for "Gothic shaped" read L-shaped.

VOL. XIII. NO. 3.—BOTANICAL GAZETTE.—MARCH, 1888.

Asa Gray.

Three months ago the sad news that Professor Gray was stricken with paralysis and that there was slight hope of his recovery brought deep sorrow to all the friends of botany in this country. All hoped and prayed for the best, but his time had come, and we have all lost a revered teacher and a true friend. This is no time for a cold review of his scientific work nor need we record the incidents of his life, but, while our recent bereavement rests heavily upon us, we may well recall those personal traits which endeared him to us all. In recounting his own personal experience the writer feels assured that, in all that concerns those qualities which made a deep impression at the time and still linger as a precious memory, his experience was the experience of all who knew Prof. Gray, and he trusts that the tribute which he can but imperfectly express will find a response in the hearts of all American botanists.

Although nearly twenty-five years have passed, it seems but a short time since the writer first met Prof. Gray in the class-room. Having previously studied the Structural Botany, and being familiar to some extent with the Manual, he was curious to see their author, and pictured to himself an elderly man, learned, of course, but probably unapproachable. How different the reality! He saw a young-looking man, with strikingly bright and expressive eyes, quick in all his motions, and so thoroughly in earnest and absorbed in his subject that he assumed that all his hearers must be equally interested. There was an air of simplicity and straightforwardness without a trace of the conscious superiority or the pedantic manner which so often accompanies learning, so that he seemed to be one of us, a student among students. In those days all students were required to study botany for one term, and, although there were, of course, some to whom the subject itself was distasteful, the instructor was beloved by all. The lectures were then given in an old room in Harvard Hall, which had once served as the college library and afterward as a sort of museum. All the material for the botanical lectures had to be brought from the garden, and twice a week, as the spring advanced, we used to see him hurrying down Garden street, a most picturesque object, so covered by the mass of branches and flowers which were to illustrate the lecture that his head and body were hardly visible. No provision was then made for those who wished to continue the study of botany beyond one term, but, although it must have been a serious drain on the time intended for his own scientific work, no student who expressed a desire to learn more than the college authorities required failed to receive from him all the special instruction he needed. The few who gathered round the little table in Harvard Hall in pursuit of knowledge which did not count in the college reckoning will never forget the untiring patience with which he explained what then seemed difficult, the contagious enthusiasm with which he led them on from simple facts toward the higher fields of science, or the tender personal interest which he showed in their hopes and half formed plans for the future—an interest which, on his part, only strengthened as years passed on, and makes them now mourn, not so much the death of a great botanist, as the loss of a sympathizing friend.

The same simplicity and sincerity, the same enthusiasm and sympathy with the work of others, characterized him to the end. Only the day before he was prostrated with paralysis he conversed with the same clearness and vivacity, and exhibited the same lively interest in what was being done by botanists at home and abroad, as in his younger days. Although far along in years, he always remained young in spirit. Time may have bent his form a little, but it could not cloud the cheerful, happy heart nor dim the alert mind which made his presence a joy in any company, grave or gay, old or young. This cheerfulness was not that which arises from mere animal spirits. It came from a deep conviction that everything, whatever it may seem to be, is really good. This faith and abiding hope which sprang from within made itself constantly felt in his intercourse with others, and inspired them, for, while those around him were despondent, he always felt that in the end everything would turn out well. Even the death of the scientific friends with whom he had been associated for many years did not depress him as it did others. He treasured their memories without repining, and no one could so well as he rehearse the story of their lives and work, or express the words of deep sympathy which many felt but could not utter.

In nothing was his kindly disposition better seen than in his criticism of the work of other botanists. His own standard of work was so high that he might well have been pardoned had he shown little tolerance of the cruder work of others. But his criticisms, always discriminating, although they were at times severe, were never ill-natured nor personal, and among the countless reviews which he wrote there is scarcely one in which there is not something of commendation and encouragement to the author. His view of botany was broad, and he had no patience with those who sneer at work which is not done in their own fashion, or in a direction which accords with their own tastes. From the nature of his training, and the condition of his surroundings, his own work was confined principally to descriptive phænogamic botany, but he always appreciated and encouraged workers in other fields, and was especially eager to hear the results obtained and the methods pursued in what may be called the younger departments of the science. Being himself liberal in his conception of botanical work, he claimed that others should be equally liberal, and he protested against the narrowness which has of late appeared in some quarters and claims that there is nothing worth studying except histology and life histories.

The mental activity of Prof. Gray was certainly extraordinary. He had no idle moments. To him leisure did not mean a respite from work, but rather an opportunity for doing something more. After a hard day's work on the Flora he would sit down in the evening as fresh as ever, and dash off reviews and notices with an ease and skill really marvelous. He wrote as easily as he talked, and all his writings, even the most unpretentious, were in the same graceful, flowing style, rippling with a delicate humor and sparkling with imagination. The social and scientific meetings, which he enjoyed so much, also demanded from him considerable labor, for, as he was generally expected to speak, and was not contented with the formal phrases and rambling remarks of extemporaneous speakers, he usually, on such occasions, presented carefully written papers. In his later years his friends urged him to take more rest, but it was of no use; unless he was at work he was not happy. One might have supposed that, if ever, he would have felt that he could afford to rest on his seventy-fifth birthday, when the memorial vase was presented and letters of congratulation poured in from all parts of the land. But no; affected as he was by the unexpected testimonial of respect and friendship, he still kept at work, and when a friend, late in the afternoon, remarked that it must have been a great pleasure to him to read the friendly greetings, he replied: "I have not read them yet. I must work now. This evening I shall have time to read them."

To speak of his hospitality might, in some connections, appear ungracious. But here, as botanists, we may touch upon a subject associated by us, especially, with so many tender recollections. When we heard that Prof. Gray was dead we recognized the irreparable loss to American botany in the death of its leader, but our first thoughts turned to the happy home now so deeply afflicted, and we recalled the bright days when all were welcomed with a sincere and hearty greeting. No matter whether a titled foreigner, or a poor, and perhaps friendless, student from our own land, all botanists were welcomed with the same unostentatious hospitality, guided by that intuitive delicacy which anticipates the wishes of others, and draws timidity from its reserve. Many, many botanists now count among their happiest hours those spent at the old house in Cambridge, and, with sorrow mingled with gratitude, sincerely hope that their sympathy may prove, in some measure, a consolation to his bereaved wife, his companion for many years, his counterpart in all that is gentle, true and noble. For a while we may think only of what we have lost, but when time shall have blunted the edge of our sorrow we shall recognize that the best part of a well-spent life is the fragrant memory which it leaves behind. W. G. F.

Cambridge, Mass.

Iowa Peronosporeæ and a dry season.

BYRON D. HALSTED.

The readers of the BOTANICAL GAZETTE who are interested in the downy mildews and their allies may desire to learn of some observations made upon this group of destructive parasites in connection with a season of excessive dryness. For the last two years central Iowa has been visited by a drought unequaled in the history of the state, a drought which not only rendered the meadows and pastures brown and lifeless in midsummer, but was so prolonged as to empty the "never-failing" wells and dry up streams of considerable size.

There is, perhaps, no better way of treating the subject than that of taking up the species of the group, one by one, in the order in which they are given in Dr. Farlow's paper upon the "Enumeration of the Peronosporeæ of the United States," which was published in the GAZETTE for November, 1883, and to which additions were made in March, 1884.

Phytophthora infestans DBy. No signs of this rot of the potato have been observed the past season. Two years ago was an average one, and there were many complaints from all parts of the state. More than half of the potatoes in some sections rotted either before they were dug or while being stored for winter use. Tubers from the college gardens and root-houses showed the rot fungus. Last year there was very much less, and this season there has been entire freedom from the disease in this locality.

Peronospora viticola DBy. Two years ago the wild canes of Vitis riparia were, in some instances, dwarfed and covered with a thick felt of white down to the earth surface. None of this mildew has been found the past season, although the search for it was frequently made in the same places where it was so violent in its attacks two years before. No signs of the mildew could be found in the large college vineyard, where many sorts of cultivated grapes and a few scattered vines of the wild species are grown.

Peronospora Halstedii Farl. is the most common species of this vicinity. Its hosts are numerous, the leading ones of which are several species of Helianthus, Silphium, Eupatorium and Bidens, and a very long list of other genera, all of the order Compositæ. Last season Helianthus grosse-serratus was added to the host list of this vicinity, and this season Bidens connata var. comosa was found infested. Two years ago specimens of this species were found at almost any time. Last season it was only moderately common, but this year it has been found growing only upon those composites which thrive in wet places. It has been rare upon Helianthus, not found at all upon Ambrosia artemisiæfolia, Solidago Canadensis or Eupatorium and Silphium species. In short, the genus Bidens has been the only one which could furnish any considerable supply of the species. Bidens frondosa, B. chrysanthemoides and B. connata were infested, but only those plants which were found in moist places and exhibited a rank growth of succulent herbage.

Peronospora obducens Sch. upon Impatiens fulva, although found in small quantities in ordinary seasons, has not been met with the past year.

Peronospora Geranii Pk. upon its common host, Geranium maculatum, has not been observed this year; but in May Mr. A. S. Hitchcock collected it upon G. Carolinianum at Iowa City, and thereby adds a new host for the state. It was not at all common.

Peronospora pygmæa Unger on Anemones has not been obtained this year.

Peronospora gangliformis DBy. was very "shy," as the horticulturist might say. Occasionally it appeared upon the lower leaves of Mulgedium leucophæum. The Nabalus albus and species of Lactuca, which are hosts, grow mostly upon dry ground, and in their dwarfed condition the present year were spared the inroads of the mildew.

Peronospora parasitica Tul. is one of our most common species upon various cruciferous hosts. In ordinary seasons Lepidium Virginicum is much infested and has its branches strangely distorted. This year the pepper-grass has been quite free from attacks, excepting the seedlings, which, for a few weeks in spring, were badly infested. This species lives over the winter in these seedlings, and when the spring comes the mildewed plants communicate the trouble to other plants by means of the multitudes of conidial spores. The vigor of its attacks upon the young pepper-grass makes this mildew one of the useful weed-destroyers. It deals in the same way with the shepherd's purse. During the present season only a small percentage of the usual amount has been observed. Of all the hosts, it has been the most abundant upon Nasturtium palustre. During June the lower leaves of this host, lying close upon the moist ground, on the borders of streams, were quite generally attacked. A little later, when the drought had progressed farther, it was not at all abundant. In some specimens examined the conidiophores were not more than one-fourth the normal size. Other parts of the same patch, however, showed all gradations, and it may be observed that a leaf parasite may be dwarfed as well as its host.

Peronospora Potentillæ DBy. was common on Potentilla Norvegica early in the season, where the host was growing on the sloping borders of low, wet places. It soon disappeared as the dry weather of late spring arrived.

Peronospora Claytoniæ Farl. is a recently described species, and has not been seen in Iowa. It was abundant in southern California, near Santa Barbara, where, during last winter, the writer found it upon the leaves of Claytonia perfoliata, but only where the host was growing luxuriantly in damp shady places. Another new host is a species of Calandrinia, upon which the same mildew was found in abundance. This low Calandrinia, probably C. Menziesii, grows in open dusty stubble-fields. It must, however, be remembered that this host is the purslane, so to speak, of the western coast, and is a succulent plant which is full of moisture and bathed by the heavy dews of that region. Even though the host thrives in the dust, the parasite is by no means a lover of dryness. It was also observed that the most thrifty mildew was upon the best watered and shaded plants.

Peronospora Arthuri Farl. was common enough on Œnothera biennis in 1885, but the past year it was found on only a few plants, and they were growing in a rich, moist, shady situation. The year before it was more abundant, and was found at Manitou, Colorado. The single infested plant grew in Englemann's Cañon, in a spot where the hot drying sun rarely reached it.

Peronospora effusa Rabh. is usually abundant upon Chenopodium album, but has been rare for the last year.

Peronospora Polygoni Thuem. is far from common with us on Polygonum dumetorum. Mr. Hitchcock found a few specimens upon P. aviculare at Iowa City, in May, 1887, and thereby adds another host for the state.

Peronospora alta Fcl. has been almost entirely absent from Plantago major for the last year. In 1885 it was one of the first of its family for the students to find on their collecting tours.

Peronospora Trifoliorum DBy. has heretofore been a common species upon Astragalus Canadensis, and especially on Vicia Americana. Upon the latter it was so abundant two years ago as to almost destroy the host in whole patches. This year it was obtained only after long search in the moistest place in which the vetch will grow.

Peronospora Euphorbiæ Fcl. is a species which quickly diminishes in times of drought. It is not uncommon on Euphorbia maculata in a wet season, but has been rare, indeed, for the past two years. A new host, E. serpyllifolia, was added last year by Mr. Hitchcock, who found it at Jewell Junction.

Peronospora leptosperma DBy. was easily collected in 1885, on both Artemisia biennis and A. Ludoviciana. During the present season it has been met with only a few times on A. biennis, growing in moist places, in cuts along a railroad track, and only in small scattered patches upon the lower leaves.

Peronospora sordida Berk. has been a good illustration of the influence of moisture upon the development of mildew. The host, Scrophularia nodosa, is a common plant on the banks of streams, especially when the slope is steep and without sod. The Peronospora was frequently looked for, but it appeared in its usual abundance in only one place, and this was at a bend in a stream, where the host grew close to the water and tall rubber boots were required to carry the collector over dry-shod.

Peronospora Lophanthi Farl. on Lophanthus scrophulariæfolius is a rare species in the state, and was not found at the college before the present year. It can not, therefore, be used as an element in the argument in considering the influence of dry weather upon the prevalence of Peronosporæ.

Peronospora graminicola Schroeter, which was abundant last year upon Setaria viridis, transforming the inflorescences of this useless grass into strange shapes, has been far less common the past season. Not more than one-tenth as much was found this year upon the same area, namely, a young cherry orchard, left under the same culture as last season. It was, however, discovered this year upon Hungarian grass (Setaria Italica), where it distorted the host in the same manner as on the foxtail, as illustrated in the GAZETTE, XI. 272. What the mildew may do in a moist year is only conjecture, but the species now comparatively new to America may prove a serious hindrance to the growth of one of our leading forage crops, and there is danger of its spreading to other standard cultivated grasses.

Peronospora calotheca DBy., not in Dr. Farlow's lists, is ordinarily frequently met with upon species of Galium. This season it was not found until October 14, when it was collected in abundance upon seedling bed-straws, which had come up in a rich mold since the September rains. This seems like a clear instance of fresh-growing plants being favorable for the development of the Peronosporæ.

The genus Cystopus has four known species in the state.

Cystopus candidus Lév., like Peronospora parasitica, is confined to the Cruciferæ, and like it, also lives over the winter within the tissue of seedling plants which spring up in autumn. This has been observed in particular with shepherd's purse, and it may help to explain the absence of oöspores in this host. It is not unreasonable to suppose that a form of fruiting may be omitted when it is not essential for the continuation of the species, as has been shown to be true in species of Uredineæ. There was an abundance of the Cystopus on Capsella early this spring, because the late rains of last year permitted the seedlings to make a good growth, and become thoroughly infested before the season closed. This spring these same plants grew and produced a large crop of spores, which probably would have rapidly spread to other plants had not the dry weather prevented. In June there was very little of the mildew. It was fairly abundant upon Lepidium Virginicum in early spring, but soon disappeared. Two years ago, in a fairly moist year, the inflorescences (flowers, seed-vessels, etc.) of the garden radish were very generally attacked, and often distorted beyond recognition. This season none of this mildew was found in similar situations. Late in October it was collected in quantity upon young plants of Sisymbrium officinale, which had developed in a moist shady place, after the rains of early September.

Cystopus cubicus Lév. is the least common species of the genus, and for the last two years has been comparatively rare. At distant intervals it was found upon Ambrosia artemisiæfolia.

Cystopus Bliti Lév. occurs upon an increasing list of hosts. Up to the present year it was known in the United States on Amarantus hybridus, A. retroflexus, A. blitoides and Acnida cannabina. The additional hosts for 1887 are Amarantus albus and Montelia tamariscina. Upon both these new hosts the mildew was far from rare. The Montelia grows only in low moist ground, and what effect a wet season may have upon the abundance of its parasite remains to be determined. The host most commonly infested is Amarantus blitoides. This low-spreading weed grows in dry places, even upon gravelly paths and roadways. It is, however, a thick, rather succulent-leaved plant, and, like the garden purslane, is itself full of moisture, even though the surroundings are arid. Nevertheless, it was observed that the greatest development of the mildew appeared upon plants which were most favored with moisture and shade.

Cystopus Portulacæ Lév. is the last species of our list, and one of no little importance in its bearing upon the question hand. At first sight, it seems to give evidence contrary to that of the other species of the group. It seems to have been more abundant during the last season than ever before, but we must remember that its host, Portulaca oleracea, is a low juicy plant, even when growing upon the dry hot earth. The mildew was therefore supplied with plenty of moisture. That it seemed to thrive better the past year than before may arise from a lack of vigor in the host, so that the same or a smaller actual amount of the parasite gave more evidences of destructive work during a dry season than on an average year. On such a year as this there are greater facilities for the quick dispersion of the conidial spores. The host, being low, receives all the dews, and the dry, dust-like spores, which have been scattered during the day, germinate in the moisture of the night. Nevertheless, it is probably true that, while purslane has this year shown increased effects of the mildew, it has been due to weak host plants, and not that the dry weather has directly favored the mildew. One thing in this connection may be noted: the stems of purslane badly affected were upright, while those not showing the disease retained their normal prostrate position. It was not uncommon to see three or four badly mildewed branches standing vertical, while the more healthy portions of the plant had the ordinary spreading habit. Whether intentional or not, it is easy to see that the elevated position of the infested branches aided materially in the spreading of the spores. In walking over a piece of ground covered with purslane, the feet will hit the dusty, spore-laden, upright stems, and send the conidia to some distance. The same is, of course, true when the feet of passing animals strike the vertical branches.

To summarize: the facts of observation show that the species of Peronosporeæ are best suited to moist weather. No member of the genus Peronospora has been as abundant during the last two seasons of drought as before. There was a decided decrease of mildew the past season over last year. In general, the mildews were found in early spring, while moisture abounded; after this, all through the dry rainless summer, they occurred in limited quantities, and only upon hosts in moist situations, along streams and the edges of pools. A few weeks after the refreshing September rains mildews were found in abundance upon seedling plants growing in shady places. The genus Cystopus seems less influenced by drought, but, as a rule, there was less of any of the species, and the infested specimens were those growing in the best situations for obtaining moisture. In all cases when the Peronosporeæ flourished it was with succulent herbs, and even with these there was probably less growth of the parasite, and sometimes a greater manifestation of disease, due to lack of resisting power in the host; so that these instances are no exception to the rule that dry weather is not advantageous for the growth of the Peronosporeæ.

Botanical Laboratory, Ames, Iowa.

BRIEFER ARTICLES.

Heinrich Anton DeBary.—Heinrich Anton DeBary, professor of botany in the University of Strassburg, and editor of the "Botanische Zeitung," died in Strassburg, after a long severe illness, on the 19th day of January.[1]

Professor DeBary was born in Frankfort-on-the-Main on the 26th of January, 1831. He completed the course of study at the Gymnasium of that city, subsequently studied medicine at the universities of Heidelberg, Marburg and Berlin, and in the year 1853 entered upon the practice of medicine in his native city. During his university studies his natural inclination led him to devote much attention to botany, and it was particularly through the influence of the admirable and thorough instruction of Alexander Braun, then professor of botany at the university of Berlin, that he became specially interested in the science, which he afterward pursued with such eminent success.

In the year 1854, or when but twenty-three years of age, he became instructor (*Docent*) in botany at the university of Tübingen, and in the following year (1855) he was appointed professor of botany at the university of Freiburg in Baden, where he remained until 1867, when he accepted a similar position at the university at Halle, and in 1872 he was called to the chair of botany in the then newly opened German university of Strassburg, which position he occupied at the time of his death.

The first botanical researches of DeBary, which were published before entering upon his career as a teacher, were entitled "Beitrag zur Kenntniss der Achlya prolifera, Zygomyceten Familie der Pilze" (in 1852), and "Untersuchungen über die Brandpilze und die durch sie verursachten Krankheiten der Pflanzen" (in 1853). Among his larger and most widely known works may be enumerated the following: "Beiträge zur Morphologie und Physiologie der Pilze," in five parts (1864 to 1882), "Vergleichende Anatomie der Vegetationsorgane der Phanerogamen und Farne" (1877), "Vergleichende Morphologie und Biologie der Pilze, Mycetozoen, und Bakterien" (1882), and "Vorlesungen über Bakterien" (1885). Several of these works have been translated into English or other languages, and are well known to American botanists. In addition thereto, DeBary has published a very large number of special monographs; and the many valuable contributions from his pen contained in the "Botanische Zeitung," which has been so ably edited by him since the year 1866, also reflect the accurate and painstaking investigations of this talented and renowned scientist.

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[1] Our notice of DeBary's death in the preceding number, taken from *Pharm. Runds.*, is corrected as above by the announcement in *Botanische Zeitung* for January 27.—EDS.]

As a teacher Professor DeBary was characterized by great clearness of expression, and the facility which he possessed for demonstrating the subjects of his lectures by crayon sketches or impromptu drawings. His reputation as an investigator had long extended far beyond the limits of his native land, and for many years students and teachers of botany from distant countries, including many Americans, were attracted to his laboratory. In his relations with students, or in conducting examinations, Professor DeBary was always just and considerate, and in social intercourse he was most amiable; but on no occasion was his genial temperament more manifest than on the frequent botanical excursions which he was accustomed to make with his pupils during the spring and summer to the adjacent fields and forests, the more extended rambles in the Vosges and Black Forest, or the occasional visit to some alpine peak of Switzerland.

In his death, preceding by a few days that of his eminent friend Dr. Gray, the scientific world has lost one of its noblest and most distinguished representatives, and on this side of the ocean, as well as in other lands, his memory will long be cherished and his name revered.

F. B. POWER.

Testimonial to Dr. Asa Gray.—At the regular meeting of the Hamilton Literary and Scientific Association held in their rooms, Hamilton, Ontario, Canada, February 9, 1888, the following resolution was unanimously adopted:

WHEREAS, This association has heard with deepest sorrow of the death of Dr. Asa Gray;

Resolved, That, as a mark of respect to the memory of the deceased, there be transmitted to his family a record of our profound regret at such a calamity to the botanical world. That in his life he furnished a shining example of devotion to science and thoroughness of investigation which will always command our admiration and respect, and that, though of another nationality, we cherish and revere his memory, inseparably interwoven not only with American botany, but with the development of botanical science itself. T. J. W. B.

A satisfactory ruling at last.—The following letter explains itself, and its contents will prove highly satisfactory to all naturalists who wish to transmit specimens by mail:

POST-OFFICE DEPARTMENT,
OFFICE OF THIRD ASSISTANT POSTMASTER-GENERAL,
WASHINGTON, D. C., February 11, 1888.

Editors Botanical Gazette:

SIRS—Your letter of the 4th inst., addressed to the postmaster-general, has been referred to this office.

Under the recent act of congress in relation to permissible printing and writing upon second, third and fourth-class matter, there may be placed upon specimens of dried plants, or on any other natural history specimens, to be transmitted by mail, without subjecting them to other than the fourth-class rate of postage, labels bearing the written names of the specimens, locality and date of collection, and the collector's name—where these inscriptions are wholly for purpose of identification or description.

The labels you submit, and which are herewith returned, are therefore permissible. [These labels are of the usual form, giving the above data.—EDS.]

As this specific ruling under the act referred to has never been promulgated, it is not unlikely that specimens sent by mail with such written descriptions will be subjected by postmasters occasionally to delay, and it may be to improper exactions of postage. To prevent this as much as possible, publicity will be at once given to the ruling.

Yours, very respectfully, H. R. HARRIS,
Third Assistant Postmaster General.

Further notes on imbedding.—In the July number of the BOTANICAL GAZETTE for 1887, p. 172, the editors noticed a method for imbedding delicate plant tissues which I described in the *Bot. Centralblatt.* Since the publication I have had opportunity of gaining more experience in the use of this method, leading me to modify it slightly. In the first place, I now use absolute alcohol, where I formerly only used the strong methylated spirit of commerce. Further, I now leave specimens to be imbedded for twenty-four hours in pure oil of cloves (after they have sunk), twenty-four hours in pure turpentine, twenty-four hours in turpentine saturated with paraffine, and twenty-four hours in melted paraffine. Although much more time is thus required, the results are more reliable, and I can now imbed, by my method, without previous staining in borax-carmine, and thus considerable time and trouble is saved.

Perhaps I may be allowed to add that sections fixed to the slide with collodion stain very well with Bismarck brown, and can then easily be photographed. Bismarck brown[1] stains all cell walls. If Kleinenberg's hæmatoxylin is used in addition, the cellulose walls turn blue, while all other walls retain their yellow color, and thus a nice double stain is effected. If sections of young tissues are treated in this way, the process of lignification in vessels can be easily traced; and if the hæmatoxylin is allowed to act a sufficient time on the sections, the structure of the protoplasm will be brought out.—SELMAR SCHÖNLAND, *Botanic Garden, Oxford.*

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[1] I prepare the solution of Bismarck brown in the following way: Saturate 1 part of absolute alcohol with Bismarck brown, and add 2 parts of distilled water.- A solution in 70 p. c. alcohol, as often used by zoölogists, does not stain lignified cell walls very readily, and the solution in water which has been heretofore used by botanists is said not to keep very well.

EDITORIAL.

If we were to give a list of the numerous papers and periodicals received containing notices of Dr. Gray's death, it would represent the expression of very many botanists. The sorrow over this sad event finds as wide an expression as did the warm and hearty response to the proposed memorial vase for his seventy fifth birthday. The burden of these notices is the one constant refrain, that not only have we lost our leader, but, more than that, our friend. When did a scientific man ever leave so fragrant a memory? When will we find that combination of graces in any other? "We will never see his like again," is the very common expression. If this unanimous showing that the best part of a man is his kindly, lovable spirit would only inspire every American botanist to cultivate it, Dr. Gray's teaching would reach much farther than the department of botany. A man whose keenest criticism is so kindly that it attracts and stimulates, whose wide charity sees good in every worker, however obscure, is one who must win to himself an army of followers who will ever use his name as an inspiration.

The editors have repeatedly called for contributions from their friends representing all departments of botany. This science has become so many-sided, so cut up into specialties, that even the nomenclature of any one department is strange to students in others. The result has been that now one department, now another, has been represented in our pages, and no botanist has found his specialty ignored, nor as fully treated as he would have liked. It is a good deal like the meetings of the biological section in the American Association, where one listens to many things he does not pretend to understand in order to hear the few things that he does. We want to call attention to the fact that if any botanist thinks his turn is a long time coming he has but to speak and he will be heard. If workers in phanerogamic botany feel that they are not sufficiently represented in the pages of the Gazette, the remedy lies with them, for our pages are for botany in all its phases. If the "cryptogamically-minded" feel pushed aside, we are waiting and anxious to hear from them. And so with anatomy, physiology, etc., etc. There is one thing we desire to guard against, and in this we must have the co-operation of our friends. The Gazette must represent the best botanical activity of this country, and much of this activity is, of necessity, so technical in its expression as to be almost unintelligible to the general reader and unprofessional worker. The danger we refer to is that unprofessional workers are so sensitive that they feel pushed aside whenever a professional appears with a technical paper. We want our friends to understand that a very large number of our readers are chiefly interested in the unprofessional notes that come, free from the smell of the laboratory, with the freshness of the open air about them. Let every botanist who calls himself "only an amateur," and is modestly keeping silent, apply this writing to himself, and know that what he can say finds as large an audience as does the technical paper of his professional brother.

OPEN LETTERS.

On some mistaken estimates made by amateurs.

I do not wish to be understood as criticising adversely the literature of the laboratory when I say that its influence has led to mistaken estimates on the part of amateurs and school-teachers. The literature itself embodies the results of a vast amount of painstaking research on the part of students who have been able to give the labor of years to their favorite pursuit. The amateur can give to botany but the few hours of an occasional holiday. The student, with commendable zeal, puts devotion to science first and the good of the individual second. We admire the scorn with which he rejects the thought of "an indolent self-culture." With the amateur the good of the individual should, just as clearly, come first and botany second—very important, no doubt, but still second. It should be valued directly in proportion as it ministers to his intellectual needs. Does it help to a better style of life? Does it help in the achievement of a higher manhood or womanhood? Well, if not, *drop it!* Here is a fundamental distinction, so deep and far-reaching that I do not hesitate to say, in all seriousness, that I consider the dead-in earnest laboratory-worker the last person qualified to pronounce an *unbiased* opinion on the question, what work had best be undertaken by amateurs in America.

The first, and least harmful, mistake made under the influence to which I have alluded is an extravagant overestimate of the *educational* value of laboratory work. Both in the high school and college, so far as I have seen, it begets a spirit of inquiry into facts curious and interesting enough in themselves, but of the relative significance of which no cognizance is taken. The student does not "digest what he learns into learning." An elaborate thesis results, for instance, in comparing the cell-structure of the leaves of this order of plants with the cell structure of the leaves of this other order of plants, the whole abundantly illustrated by an elaborately prepared series of slides—and there it ends! No generalization of agreements or differences, no correlation of certain peculiarities of cell-structure with recognized natural affinities, not so much even as the recognition of an *a priori* probability that a general similarity or dissimilarity might obtain, which an examination of the facts showed was not the case—nothing! Observation without judgment! Only this and nothing more. Were a student, using a common pair of eyes, to do the same thing, comparing in this thoughtless way, for instance, the gross-anatomy of the leaves in question, his teacher would tell him—and be right in telling him—that his work was simply silly. I fail to perceive how the intervention of a compound microscope is going to stay the verdict. Furthermore, it may be seriously questioned if the power of observation, *per se*, is in any considerable degree capable of cultivation. Good observers are born, not made.

The second and by far the most pernicious mistake has been on the part of many to ignore the one high use which the study of botany, above all other things, can be made to subserve, viz.: training the mind to grasp abstract ideas and to bring the various parts of an extensive subject into mental co-ordination. This *is* education, the very essence of intellectual power. Mind you, I am not discussing the advance of science; I am discussing the advance of man!

When George Eliot, one of the foremost philosophic minds of the age, was finding pleasure in learning the names of the plants of Ilfracombe as "part of the tendency that is now constantly growing in me to escape from all vagueness and inaccuracy into the daylight of distinct, vivid ideas;" when John Stuart Mill was botanizing over the moors of England and turning aside at Avignon to tramp up the bed of the Durance collecting—of all things—willows! are we to suppose for a moment that these two eminently clear-headed persons did not know whether they were wasting their time or not? Nay, so far as Mill is concerned, we know that he made a very considerable herbarium, doing the work with his own hands, and we may safely infer his motive from what he says in the *Logic*: "The proper arrangement of a code of laws depends upon the same scientific conditions as the classifications in natural history; nor could there be a better preparatory discipline for that important function than a study of the principles of a natural arrangement, *not only in the abstract, but in their actual application to the class of phenomena for which they were first elaborated, and which are still the best school for learning their use.*" If popular interest in systematic botany has "declined" in this country, the causes are not far to seek, and it were an ungracious task to recount them here. The indications are that they have already spent their force. M. S. Bebb.

Rockford, Ill.

The death of Dr. DeBary.

Editors of Botanical Gazette: I promised to write you a few lines in December, from the laboratory in Germany in which I might be at work, but knowing that I decided to enter Professor DeBary's laboratory for the winter semester, you can readily understand how I deferred writing from week to week, hoping that I might send some cheering and hopeful word in regard to its distinguished and beloved chief. Unhappily, my first word to you is to chronicle his death, which occurred at half-past two on the afternoon of January 19. Of this event you will have heard before my letter reaches you, and others of our own country, who knew DeBary and his work infinitely better than I, will, no doubt, furnish your readers with such biographical and critical notices as you may desire; but possibly a few words in regard to his illness and death by one near at hand may not be uninteresting.

Professor DeBary was much annoyed toward the close of the summer semester by pains in his face, supposed to be neuralgic or else arising from the teeth. He made a voyage to England, to attend the meeting of the British Association, I think. This and the return voyage seemed to aggravate his trouble. On account of the inflammation and alarming character of the disease upon his face, a surgical operation became necessary about October 1. He was completely prostrated from the disease and loss of blood, remaining in the care of nurses for several weeks at the Bürger Spital in Strassburg, where the operation was performed. His return to his residence, which, according to an arrangement not infrequent with other prominent German professors, is in the Botanical Institute—*i. e.*, the building devoted to botanical work—was looked forward to with much silent interest by the little corps of special student and the instructors, as we all hoped that, according to his own desire and anticipations, he would soon be with us to direct the laboratory work as of old. He came down soon after November 1, and the week after delighted everybody by coming into the laboratory. These visits continued, with some interruptions, for several weeks. I had the pleasure of meeting him, of talking with him to a limited extent, and occasionally he would inquire how my work was progressing. He appeared, as he was said to be, the kindest of men to those who worked under him. He was quick and intense in all his movements and operations. Every action and word of his former pupils show not only a profound regard for him as an authority in science and a great teacher, but a genuine affection for him as a man and a friend. It was clear, however, that his nerves and general health and strength were greatly affected; his visits became rarer, and soon after December 1 he appeared no more in his laboratory. During the holidays his colleague, Professor Dr. Zacharias, who has directed my own work in DeBary's absence, and who has been, both officially and personally, very kind and delightful in his intercourse with me, informed me that all hope of Professor DeBary's recovery had been abandoned. He suffered very much until within a few days of his death, when he became partially unconscious.

His death is regarded here as a very great loss to this university, as it is everywhere to the scientific world. He was only 57, hence only in his prime as a scientific investigator, and therefore all botanists lament the valuable work DeBary might have accomplished had he been spared. His fellow townsmen and university colleagues, while knowing well his world-wide reputation, feel strongly the loss of his well-balanced judgment, and his lively interest in all worthy objects connected with Strassburg affairs. He often attended the horticultural society of Elsass, as well as their agricultural society, and in university circles his knowledge of men and affairs was regarded as very superior; and his judgment had great weight in such questions as the selection of professors and the development of new lines of university work.

The burial service at the Botanical Institute was on Sunday, January 22, conducted by the Lutheran pastor of the *Neue Kirche*, Strassburg. Besides his remarks, and a burial hymn, sung by members of the student musical club, addresses were also made by Professor Kussmaul, of the medical faculty, Professor Fittig, of the chemical department, and Professor Zœpffel, rector of the university. Furthermore, notwithstanding the rain which fell at short intervals, the great affection felt for DeBary was shown by the large number of students, professors and other friends who walked in the long procession escorting his remains across the city, through the Weissthurm Gate, to the little cemetery beyond the walls called *Kirchhof St. Gallen*. Nearly all the student "corps" and *Verbindungen* were represented. De Bary was even greater as a teacher and organizer of work, I am disposed to believe, than as an investigator. In enumerating those who have been his pupils, or worked in his laboratory, the list seems to include a great majority of those young and middle-aged men now engaged in the most advanced lines of botanical work in the world. Several of these old pupils were present at the burial, among them Count Solms-Laubach and Professor Stahl.

To-day it is announced that Count Solms, who had already accepted a call from Göttingen to Berlin, will recall his acceptance of the Berlin position in order to become DeBary's successor here at Strassburg.

Strassburg. WILLIAM R. DUDLEY.

CURRENT LITERATURE.

Fossil woods of the Northwest.[2]

In these few pages are recorded the latest results of Dr. Dawson's investigations of the fossil woods of the northwestern portions of North America. After reviewing briefly the work done by others in this field, he states as his opinion "that no specific or even generic distinctions can be made with absolute certainty on the evidence of structure alone." For monocotyledons and dicotyledons this statement is undoubtedly true at present, but for conifers perhaps a little more latitude might be admitted, at least as regards generic distinctions. The genus Pinus can be with certainty distinguished, as can several other generic types.

Following out this idea, he has found it expedient not to give specific names in any case, particularly, he says, "as it seems in every way likely that most of them belong to species otherwise named from specimens of their leaves and fruit." They are also unaccompanied by descriptions. This view, on the whole, is to be regretted, for if paleobotany is ever to be of assistance to geology it must furnish a set of criteria, as complete as possible, by which stratigraphic relations may be determined. It would, of course, be a matter of great satisfaction if the trunks, leaves and fruits could be correlated, for we should then have very complete stratigraphic data; but as this can be done only in very rare instances, it seems unfortunate that one set of facts should be selected to the exclusion of the other.

The paper is divided into several parts, treating of various formations. Descriptions are also given of some leaves and fruits of these formations, and in conclusion deductions are made as to the relations of the Laramie to the British Eocene.—F. H. K.

Sphagnaceæ of North America.[3]

In this brief paper M. Cardot summarizes his conclusions regarding our *Sphagna*. North America possesses all the European types except S. Angstroemii, and several, chiefly southern, which are not found in Europe. Sixteen species and nine sub-species are recognized, as against the twenty-seven species of Lesquereux and James. The chief changes from their manual are as follows:

Two new sub-species (of S. cymbifolium) are added, *S. medium* Limpr. from Florida, Isle Miquelon and in Musci Bor. Am. no. 3, and *S. affine* Ren. et Card. from Florida and New York. Besides these, a number of new forms and varieties belonging to various species are described.

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[2] DAWSON, SIR WILLIAM.—Note on fossil woods and other plant remains from the Cretaceous and Laramie formations of the western territories. Trans. Roy. Soc. Canada, Section IV, 1887. pp. 31-37.

[3] CARDOT, JULES.—Révision des Sphaignes de l'Amérique du Nord. (Extrait des *Bulletins de la Société royale de botanique de Belgique*, tome xxvi, première partie.) 28 pp., 8 vo. Gand: C. Annoot Braeckman, Ad. Hoste, succ'r. 1887.

S. rubellum Wils. is reduced to a variety of S. acutifolium; S. Muelleri = S. molle: S. Mendocinum = S. cuspidatum; S. sedoides = S. Pylæsii. *S. stricum* Lindb. becomes *S. Girgensohnii* Russ.; and *S. intermedium* Hoffm. is changed to *S. recurvum* Beauv. with doubtful propriety. S. cyclophyllum is considered as probably an immature form of S. subsecundum. S. macrophyllum var. Floridanum is raised to the rank of a species, *S. Floridanum* Card. While it is a good variety, we can not see that it has any well grounded claim to specific rank. To these changes, with the two exceptions noted, our studies incline us to accede.

M. Cardot greatly desires to receive specimens of Sphagna from our bryologists, in order to make his work more complete, and we hope our collectors will not forget him in their exchanges. His address is Stenay, Meuse, France.

American Characeæ.

Botanists are beginning to understand that their best work is done by confining their attention to a single subject or a single group. Selecting some genus or order that has been neglected—and very few have not been neglected – they give it an exhaustive study, and the result is a better understanding of the group than has ever before been attained. It is in this way only that we can expect to build up modern botany. In a work[6] that lies before us the author is to be commended for his selection of a very much neglected group, and congratulated upon the very complete and careful way in which he has gone about to "work it up" This first part is but introductory, laying that foundation of knowledge which is necessary for an intelligent study of the group. The second part, promised in a year or two, will contain descriptions (with illustrations) of the species now known to inhabit American waters. The introduction contains directions for collecting, with the habitats and proper condition of the plant. The interesting observation is made upon Chara fragilis that it is universal, "found in every country and clime, in ice-water at the north and in the hot springs (boiling water) of the Yellowstone." An historical account of the group is given, followed by the discussion of germination, development of the cortex, stipules, leaves, branches, organs of fructification, development of the spore, all fully illustrated.

The part closes with a classification and synopsis of the species, prepared by Dr. O. Nordstedt and translated with his permission. It seems that before the researches of the late Professor A. Braun the classification of Charads was "confusion worse confounded." His researches into the morphology of the group laid the sure foundation for classification, and "Characeæ began, as it were, a new existence in the scientific world, almost comparable to the birth of the Linnæan system." Braun's "Fragmenta" have been edited by Dr. Nordstedt. Dr. Allen's work should stimulate botanists to collect our American species, for, according to the author, very little of it has been done.

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[6] ALLEN, TIMOTHY FIELD.—The Characeæ of America, Part I, containing the introduction, morphology and classification. 64 pp., 55 figures, large 8vo. New York: Published by the author, 1888.—$1.00.

Minor notices.

THE *Sphagnaceæ* come in for a large share of the study of mosses. Dr. Martin Waldner has published[6] details of his investigations on the development of the sporogonium of Sphagnum and Andreæa, the results of which were summarized some time ago in the *Botanische Zeitung*.[7] These researches relate almost wholly to the early stages of the development of the sporogonium, and the author has traced out with much care the position and succession of the dividing walls which cut up the oospore into segments. In both genera the origin of the spore-layer, the walls of the spore case and the columella are pointed out and illustrated on the excellent plates. For the details we must refer to the paper itself.

From the systematic side, Dr. Karl Müller (Halle) adds[8] to our knowledge of the Sphagna. The paper is prefaced by a brief characterization of seven sections of the genus for which new names are proposed. In his remarks on the specific characters of Sphagna the author indicates his belief in the autonomy of many of the forms which have been referred to the same species by recent Sphagnologists. Then follow descriptions (Latin) of thirty new species from various localities in Africa, South America, Mexico, Australia and adjacent islands.

IN HIS notes on the genus Taphrina,[9] Mr. Robinson gives a synopsis of the best known North American species, eight in number, with remarks upon their morphology and distribution. Ascomyces deformans var. purpurascens is raised to the rank of a species, and referred to "*Taphrina* Fries, char. a Tulasne emend.," as are all the species of Ascomyces and Exoascus. The paper is an outcome, we infer, of a winter's work in Dr. Farlow's laboratory.

WE HAVE received a German abstract, by Dr. Schönland,[10] of Prof. F. O. Bower's paper on the development, morphology and the vegetative organs of Phylloglossum Drummondii, which was published in Trans. Royal Soc. London for 1885. Phylloglossum is specially interesting, because it exhibits such a close correspondence of its mature characters with the structure of the embryonic Lycopodiums.

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[6] WALDNER, DR. MARTIN.—Die Entwickelung der Sporogone von Andreæa und Sphagnum. pp. 25, pl. iv. (i, ii, iii, double) 8vo. Leipzig: Arthur Felix, 1887.—M. 2.60

[7] *Bot. Zeit.* (1879.)

[8] MULLER, CAROLUS.—Sphagnorum novorum descriptio. 8vo. Separat Abdruck aus *Flora*, no. 26 u. 27. pp. 20. 1887.

[9] ROBINSON, BENJ. L.—Notes on the genus Taphrina. pp. 14. Reprint from *Annals of Botany*, November, 1887.

[10] BOWER, F. O.—Ueber die Entwickelung u. die Morphologie von Phylloglossum Drummondii. I Teil: Die vegetative Organe. (Auszug aus dem englischen Original von Dr. S. Schönland.) pp. 8, fig. 1. Sep. Abdr. aus *Bot. Jahrbücher*, viii band, 4 heft. 1887.

CULTIVATED VERBASCUMS have always been favorite plants for hybridizing. Dr. Victor Schiffner[11] has given us an interesting account of these hybrids in general, and then describes minutely some new hybrids from V. pyramidatum which were discovered in the summer of 1885 in the Botanical Gardens at Prague. They were growing spontaneously, and were of sufficient interest to justify a careful comparison of their characters with those of their parents. The hybrids studied resulted from the crossing of V. pyramidatum with V. nigrum, V. phœnicum, and two different combinations with V. phlomoides.

NOTES AND NEWS.

DR. J. T. I. BOSWELL, the well known English botanist, died January 31st.

A BILL to establish an experimental grass and forage station has been brought before congress by Senator Platt.

CENTURIES XX and XXI of Ellis' North American Fungi will be issued early in the spring—probably in March or April.

A REVISED EDITION of Underwood's "Ferns and Their Allies" will be issued shortly from the press of Henry Holt & Co., New York.

DR. ED. PALMER has just returned from Mexico. His collection of plants, some 600 species, is on the way, and doubtless contains many new things.

THE APPEARANCE of the new journal, *Garden and Forest*, has been delayed by the serious illness of Professor Charles S. Sargent, the editor in charge.

THE *Index Seminum*, the catalogue of seeds for exchange at the Jardin des Plantes, has just been received. It contains 18 quarto pages, 4 columns to a page.

THE REGENCY of the Smithsonian Institution, made vacant by the death of Dr. Gray, has been tendered by the U. S. Senate to Prof. Andrew D. White, ex-president of Cornell University.

THE *Journal of Botany* for February contains descriptions of 4 new ferns and 13 new Tillandsias. Dr. Baker, in his synopsis of the Tillandsieæ, has reached the 165th species of Tillandsia.

MR. A. P. MORGAN continues his contributions on the "Mycologic flora of the Miami Valley, Ohio," in the *Journ. Cin. Soc. Nat. Hist.* for January. The paper includes the order Thelephorei under Hymenomycetes.

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[11] SCHIFFNER, DR. VICTOR.—Ueber Verbascum-Hybriden und einige neue Bastarde des Verbascum pyrimidatum M. B. (Bibliotheca botanica, heft 3.) 15 pp., 2 plates, 4°. Cassel: Theodor Fischer, 1887.—4 marks.

THE FORESTRY CONVENTION held at Grand Rapids, Mich., January 27 and 28, was a profitable gathering. Dr. W. J. Beal presided, and B. E. Fernow, of Washington, C. W. Garfield and other well-known speakers were present.

AS THE possible successor of Professor Dickson at Edinburgh University several well known botanists are mentioned, among whom are Professor Bayley Balfour, Mr. Geddes, Mr. G. Murray, Professor McNab and Professor Traill.

THE *Italian Journal of Botany* bearing date of January 31 is principally occupied by a monograph of the genera Pleospora, Clathrospora and Pyrenophora, by A. N. Berlese. O. Beccari also describes some new palms from New Guinea.

THE REPORT of the New York Agricultural Experiment Station for the year 1887, recently distributed, contains items of botanical interest by several of the corps of investigators. The chief topics relate to fungous diseases of plants and fungicides.

DR. L. G. YATES, of Santa Barbara, California, announces a volume entitled "All known ferns." It is to be an octavo of about 300 pages, and will really be a complete index to fern literature. In its preparation the author is assisted by Dr. J. G. Baker, of Kew.

ANENT THE recent discussion on the nomenclature of our water lilies, it is to be noted that Dr. R. Caspary, in elaborating the order Nymphæaceæ for Engler and Prantl's *Pflanzenfamilien*, retains the genera Nymphæa and Nuphar unchanged and alters Nelumbium to Nelumbo.

PROFESSOR JOSEPH SCHRENK has published (with plate), in the *Bulletin of the Torrey Botanical Club*, (February), his very important paper, "On the histology of the vegetative organs of Brasenia peltata," read at the New York meeting of the A. A. A. S. last August. It is an exhaustive study of a very interesting plant.

THE *American Naturalist* appears from a new publishing house and in a new dress with its January number. The botanical department contains Schroeter's arrangement of the Ustilagineæ and Uredineæ, and the notice of a new tumble-weed from Nebraska (Corispermum hyssopifolium), besides the usual excellent *résumé* under "Botanical News."

MR. F. H. GILSON, of Reading, Mass., has begun the publication of a work entitled "Trees of Reading, Mass." Although the title is a local one, the very handsome plates, heliotypes from excellent photographs, make the work attractive to any botanist. Part I contains two elms, a sassafras, an oak and a birch, with appropriate text, and costs $1.50.

THE UNIVERSITY OF KANSAS possesses a fine collection of the fossil flora of the Dakota rocks of the cretaceous. It contains upward of 200 species, nearly half of which are new. The new species have been described by Professor Leo Lesquereux. Duplicates of 75 of them are offered for sale, including 35 new species. Professor F. H. Snow, of Lawrence, Kansas, has the matter in charge.

THE *Italian Agricultural Stations' Journal*, begun in 1872 and discontinued in 1882, is to be revived under the editorial charge of Professor Pasquale Freda, of Rome. The prospectus gives promise of an agricultural-chemical journal valuable not only to Italians, but to foreigners as well. Six numbers will appear yearly, making a volume of at least 500 pages. The subscription in foreign countries is 15 francs.

MR. JAMES M MACOUN will botanize next summer along the shores of James bay and the east coast of Hudson bay. As considerable difficulty is experienced in drying specimens, he only collects those required for the use of the Canadian Geological and Natural History Survey. He very kindly offers, however, to collect material for specialists working up any group of plants, and without any charge. He may be addressed at Ottawa, Canada.

THE FEBRUARY meeting of the botanical section of the Biological Society of Washington, D. C., presented the following programme: Notes on the Lake Superior flora, Dr. George Vasey; A visit to a fossil forest, Prof. F. H. Knowlton; Identification of fossil woods, Prof. Richard Foster; Variation of habit in Ampelopsis, Dr. C. V. Riley; New western Uredineæ, Mr. B. T. Galloway; Influence of cross-fertilization in the orange, Mr. C. L. Hopkins.

THE *Gardeners' Chronicle* (February 11) gives an illustration of Psiadia rotundifolia, a composite, styling it "the last of its race." It is a tree about twenty feet high, standing in a broad, open space near the entrance gates of the famous Longwood, St. Helena. It is actually the last living representative of the genus. It is a rare thing to see even the photograph of the last individual of a species. Kew has herbarium specimens, and has succeeded in germinating seed.

DR. M. MÖBIUS has recently published a paper in Pringsheim's *Jahrbücher*, also distributed separately, on the anatomical structure of orchid leaves as furnishing characters for classification. He finds that, as in the case of the leaves of grasses and conifers and the fruit of umbellifers, very helpful and often strongly diagnostic characters are to be found. He points out a practical application of such knowledge in determining rare and costly exotics which are not in flower.

THE ANNUAL REPORT on the flora of New York for the year 1885 by the state botanist, Mr. Chas. H. Peck, has been distributed. It covers 46 octavo pages, and is accompanied by two plates. The additions to the flora of the state number over two hundred, all but two being fungi, and thirty-seven of which are marked as new species. The Agaricinian species of Pleurotus, Claudopus and Crepidotus found in the state, numbering thirty-one in all, including two new species, are described in full, with notes.

PROF. WILLIAM TRELEASE has published his address before the Alumni Association of the St. Louis Medical College (January 18, 1888), on "Bacteria from a botanical stand-point," in the *Weekly Medical Review* for January 28 and February 4. It is an excellent presentation of a very difficult and commonly misunderstood subject before a class of students who must know something of it. Bacteriology is a tremendously exaggerated subject in the popular mind, and it is well occasionally to have the facts in the case plainly stated.

THERE HAS BEEN some uncertainty about the nutritive value of mushrooms. They are commonly ranked with meat, but a recent German writer states that it takes nine pounds of the common mushroom to equal a pound of beef. The matter has been investigated by Mr. E. F. Ladd (Rep. N. Y. Agric. Exp. Station, 1887, p. 464), who finds that mushrooms (Agaricus campestris) gathered from a pasture at Geneva, N. Y., contained 84½ per cent. of digestible albuminoids, and puff balls (Lycoperdon giganteus) from 70 to 80 per cent., according to maturity. He concludes that they compare favorably in nutritive value with meat.

BULLETIN No. 2 of the New York State Museum of Natural History (dated May, 1887), a pamphlet of 66 pages and 2 plates, by Chas H. Peck, was distributed last month. It is mostly made up of a reprint of the revised report of the botanist for 1883, which, owing to legislative complications, was never properly published, with an additional article on the New York species of viscid Boleti. There are descriptions of 57 new species of fungi, and notes on nearly as many others. The first number of this series is not yet printed. It is little short of disgraceful that important printing undertaken by the state is subjected to such exasperating delays.

REV. THOMAS MORONG, in *Bulletin Torr. Bot. Club* (January), has begun a series of papers entitled "Studies in Typhaceæ." The present number considers Typha, and, after a very interesting description of its structure, the author gives a translation of Rohrbach's classification of the species, published about 1870. In this the 13 species are divided into two groups, the first containing those with fruit having a longitudinal furrow and bursting in water, and seed with a separable outer coat; the second contradicting these characters. Our three species (T. latifolia, T. angustifolia, and T. Domingensis, the last reported from Texas) belong to the first series.

THE SARRACENIA pitchers at Kew have begun to decay owing to the putrefying mass of insects they contain. In a note to the *Gardeners' Chronicle* (January 21), Mr. Watson suggests that the secretion found in the pitchers is not necessary to the destruction of the insects caught in them, as the enormous mass of bluebottles caught in the pitchers at Kew could not have been affected by the few drops of the secretion contained in each pitcher. He also suggests that the pitchers, by entrapping such immense numbers of insects, collect "a powerful stimulant to the roots of the plants when, by the decay of the pitchers, the contents are deposited on the ground directly above where the roots find nourishment."

THE FIRST FASCICLE of *Acta Horti Petropolitani* for 1887 is at hand, and contains the customary rich installment of contributions to the geographical distribution of phanerogams. Its 400 pages and eight plates present the following contributions: Herder on the Labiatæ, Plumbagineæ and Plantagineæ of the Raddean collection from Eastern Siberia (82 pp.); Winkler on 10 new Compositæ from Turkestan, 6 of which belong to Cousinia (12 pp.); Trautvetter on the flora of Dagestania (40 pp.); Otto Kuntze on the plants of Eastern Russia (128 pp.), in which are proposed a new genus of Umbelliferæ (Schumannia) and quite a number of new species; Regel on the species of Allium (138 species) in middle Asia, and the descriptions of some plants in the Imperial Garden at St. Petersburg (113 pp.).

THE INDIANA ACADEMY OF SCIENCE held its third annual meeting in Indianapolis December 28 and 29, 1887. Besides the presidential address by Professor John M. Coulter, upon "Evolution in the vegetable kingdom," the section of botany was represented by the following papers: A chemical study of Juglans nigra, and The value of organized work in plant chemistry, by Lillie J. Martin; The late drouth and its effect on vegetation, Companion plants, and Notes on the white-spored agarics of Franklin county (Ind.), by O. M. Meyncke; Histology of the foliage leaf of Taxodium distichum, by Stanley Coulter; Stomata of Tillandsia usneoidès, by John M. Coulter; Additions to the flora of Indiana, by G. C. Hubbard; Characters in Umbelliferæ, by J. N. Rose; Lichens of Indiana, by Walter H. Evans; Life history of the plum leaf fungus, by J. C. Arthur.

VOL. XIII. NO. 4.—BOTANICAL GAZETTE.—APRIL, 1888.

New or rare plants.[1]

ASA GRAY.

Hibiscus incanus Wendl. Doubting the sulphur colored or straw-yellow petals, I referred this species to *H. lasiocarpos* Cav. in Proc. Am. Acad. xxii, 302. But I find that Dr. Chapman well knows the yellow-flowered plant, and I have now received it from Alabama, from F. J. Muller through Prof. Meehan. Chapman's character is a good one, but I have passed some dried specimens for a form of H. Moscheutos, which it much resembles. I have confirmed *H. lasiocarpos* Cav. for the hairy-fruited species, by referring to the original in herb. Jussieu at Paris. I here record the rehabilitation of H. incanus, because in these days catalogues are so numerously and promptly published.

Blepharipappus lævis. Glabrous and mostly smooth up to the few-flowered small heads: stems and effuse branches filiform: leaves all appressed and small, the upper squamaceous: involucral bracts 6 to 8, oblong: flowers open through the day (not closing in sunshine in the manner of B. scaber). *B. scaber*, var. *lævis* Gray, Syn. Fl. 1^2, 304.—E. California to S. Oregon; collected near Waldo in the latter state by *Brandegee* in 1885, and *T. Howell* in 1887. The latter indicated to me the diurnal anthesis, which, with the other characters, shows this to be a wholly distinct species.

Hieracium Howellii. Allied to H. Greenei, but decidedly tomentose-canescent, even to the similar involucre, and below more villous-crinite: stem (a foot or more high) leafy up to the panicle: pappus apparently pure white, but still young.—Deer Creek Mountains, S. Oregon, *T. Howell*, July, 1887.

Troximon barbellulatum Greene in Gray, Syn. Fl. 1^2, 437. Mr. Howell has collected this rare species, July 19, 1887, in a dwarfer form, and with pappus bristles so decidedly barbellate that it might be called subplumose!

Cambridge, Mass.

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[1] This paper, marked "BOT. GAZETTE," was found lying upon Dr. Gray's study table.

Undescribed plants from Guatemala. III.

JOHN DONNELL SMITH.

(WITH PLATE II.)

Mimosa sesquijugata. (Series *Sensitivæ* Benth.)—Fruticulose, suberect, glabrous, unarmed: stipules linear, rigid, striate, setose-ciliate, 1½ lines long; petioles firm, 12–18 lines long; leaflets coriaceous, glaucous, oblong, obtuse or acutish, mucronate, base dimidiate-cordate, 4-nerved, reticulate, 8–10 lines long, half as broad, margin and undersurface rigidly setose, interior leaflet of lower pair wanting; rhachises bristly, 1–2 lines long: flowers tetramerous; peduncles retrorsely strigillose, more than half as long as petioles; bracts subulate, ciliate, less than half as long as corolla: calyx almost obsolete, hyaline, ciliate-toothed: corolla glabrous, purple, 1 line long: stamens 3–4 lines long: legume not seen.—Near the Brazilian *M. glaucescens* Benth. *ex char.*—In rock-fissures near Santa Rosa, Dept. Baja Verapaz, alt. 5,000 feet, July, 1887. (Ex Plantis Guatemalensibus Tuerckheimianis, quas edidit John Donnell Smith, 1327.)

Melampodium brachyglossum.—Annual, herbaceous, 2–3 feet high: stem pilose, glandular above, dichotomous, branches quadrangular: leaves scabrid on both surfaces, subtriplinerved, coarsely toothed, 1½–2½ inches long, triangular, acuminate, abruptly contracted to a winged petiole dilated at base; varying to oblong and lanceolate, cuneately contracted below the middle, sessile: peduncles filiform, 1–2 inches long: heads 2 lines broad and high; involucral scales 3, shortly connate, round-acuminate, pilose; rays 6–7, quadrate-orbicular, ¾ line in diameter, 2–3-lobed, pilose beneath, yellow; fructiferous bracts rugose, callose-tuberculate; achenia incurved-pyriform, concentrically striate, 1 line long.—Coban, Dept. Alta Verapaz, alt. 4,300 feet, July, 1885, May, 1886. (Ex Pl. cit. 114, 761.)

Ardisia Tuerckheimii.—A small tree: glabrous throughout: leaves coriaceous, glaucous, lineolate and punctate beneath, entire, oblong, 3–4 inches long, a third as broad, apex caudately produced and obtuse, narrowed to a short petiole: corymbs terminal, shortly peduncled, half as long as leaves; pedicels 3–6, subumbellate at apex of flexuose rhachis and of its 2–3 primary branches, 7–9 lines long: sepals 5, ovate-oblong, a third as long as petals, persistent in fruit: petals 5, elongate-oblong, 3½ lines long, obtuse, white, like the sepals rubropunctate in lines and dots: stamens 5, 2½ lines long; anthers exceeding the flat tapering filaments, linear-oblong, quadrangular, base cordate, apex obtuse and mucronulate, biporose: style nearly equaling petals; ovules 12–16: fruit red, glandular, 3 lines in diameter, crowned with persistent base of style.—Distinguished by secondary branches of inflorescence two to three times exceeding primary ones.—Mountain forests of Pansamalá, Dept. Alta Verapaz, alt. 3,800 feet, Aug., 1886. (Ex Pl. cit. 1,035.)

Cobæa triflora.—Leaflets 3-jugate, uniform, oblong-lanceolate, tapering from the middle to an acute mucronulate apex, somewhat narrowed to a cordate-truncate base, 2½–3 inches long, marginate, petiolules 4–5 lines long: peduncles 2–3 inches long, terminal pedicel 6–8 inches long, the two lateral of later development from alternate foliaceous bracts: calyx-segments almost free, patent, lanceolate-acuminate, margins revolute, 1 inch long, like leaflets naked, yellowish-green dotted with red, pale within: corolla broadly subcampanulate, 1½ inches long, pubescent, pale-yellow, reddish below; lobes short, rounded, erect: stamens and style shortly exserted.—Leaves as figured for *C. gracilis* Hemsl. in Œrst. L'Amér. Centr. t. XVI: flowers nearest to the Ecuador *C. campanulatus* Hemsl.—Banks of Rio Cajabon, near Coban, alt. 4,300 feet, Dec., 1886. (Ex Pl. cit. 204.)

Beloperone Pansamalana. (§ *Beloperonides.*)—Fruticulose, epiphytal, prostrate: branches ascending, dichotomous, tetragonal, pubescent in two lines: leaves membranaceous, opaque, beset with cystoliths, glabrous, dark-green above, glaucous beneath, rhomboidal to elliptical, each end acuminate, 12–16 lines long, 6–7 broad, petioles 1–3 lines long: flowers 2–4, at length pedicellate in a subsessile fascicle: spatulate bracts 3 lines long, linear-spatulate bracteoles a third longer, both truncate at apex and glandular-hairy: calyx-segments linear-setaceous, 5 lines long, barbellate: corolla 18–20 lines long, scarlet; lips nearly equaling tube and each other, hairy without, glabrate within, the posterior one bidentulate, the anterior 4 lines broad with lobes 2 lines long: stamens nearly equaling lips; lower cell remote, scarcely calcarate: style shortly exsert.—Pansamalá forest, alt. 3,800 feet, Oct., 1885, Sept., 1886. (Ex. Pl. cit. 732.)

Thyrsacanthus geminatus.—Suffruticose, ferruginous-pubescent: stem tetragonal: leaves pergameneous, nitidous except veins, oblong-obovate, cuspidate-acuminate, long-attenuate to a small obtuse base, shortly petioled, 10–14 inches long: thyrsi in a brachiate long-penduncled foliaceous-bracted panicle, virgate, 6–12 inches long: cymes subsessile, at length geminate on a bipartite peduncle 3 lines long, 3–10-flowered, exceeding verticillastrate internodes, small bracts and bracteoles linear-lanceolate, pedicels 4–6 lines long: calyx-segments linear-lanceolate, 1½ lines long: corolla straight, 13 lines long, purple, tube equaling inflated throat; lobes nearly equal, oval, ciliate, posterior one erect and 2-lobuled, others reflexed and 4 lines long: stamens nearly equaling corolla-limb, cells equal; staminodes minute, uncinate.—The allied *T. callistachyus* Nees in DC. has leaves less minutely and prominently reticulated, cymes subsessile, corolla-limb smaller with (*ex* Nees) superior lobe narrow and entire, stamens very short and included.—Pansamalá forest, alt. 3,800 feet, Oct., 1885, May, 1887 (Ex. Pl. cit. 740.)

Scutellaria lutea. (§ *Stachymacris* Benth.) — Fruticose; stems terete. fusco-velutinous; branches and inflorescence canopilose, glandular: leaves like flowers sericeous and atomiferous, oval to ovate-oblong, 8–15 lines long, crenate, petioles 2–3 lines long: racemes loose of 5–6 pairs of declinate flowers; bracts 2–3 lines long, lower ones foliaceous and petioled: calyx 2 lines long, exceeding pedicels; crest in fruit enlarged to 4 lines long, obovate, appressed, yellow: corolla elongate, 1 inch long, sulphur-yellow, tube 3 lines long, throat gradually dilating, lips equal and 2 lines long; posterior lobe of upper lip small, emarginate, its lateral lobes equaling the erect crenulate plicate-edged lower lip: anthers naked; filaments margined: disk obovate, nearly equaling ovary, contracted to oblique short gynophore: nutlets globose, granulate.—Forest near Santa Rosa, alt. 5,000 feet, July, 1887. (Ex Pl. cit. 1,309.)

Dorstenia Choconiana Watson in Proc. Am. Acad. XXII, 477, var. (v. form.) **integrifolia.**—Rootstock tuberculate: stems simple or furcate: leaves entire, margins crispate and undulate: peduncles 1–2 inches long: receptacle acetabuliform, 9–12 lines in diameter, turbinate, pallid externally; border of disk green within, 2½ lines broad; alveolate areoles quadrate, white, green-bordered: pistillate florets 6–7, intermixed with numerous staminate ones: nucules stipitate, obovoid, compressed above and below in opposite axes, a line or more long and broad; endocarp shining-white, callose, delicately reticulated.—Pansamalá forest, alt. 3,800 feet, Sept., 1886, April, 1887. (Ex Pl. cit. 751.)—Freiherr von Türckheim's numerous specimens, representing all stages of growth, show no tendency toward lobing of leaves. The originals of Dr. Watson's description, sparingly collected by him in the *tierra caliente*, are somewhat less robust plants, and the leaves have a more distinctly continuous intermarginal vein; the flowers were not described, and in the specimens seen are insufficient for examination.

Asplenium Vera-pax. (§ *Diplazium*.)—Stipes tufted from a short rhizome with a few black scales toward base, 18 inches long: fronds subcoriaceous, glabrous, pale beneath, punctate, ovate-lanceolate, 12 inches long, lower half pinnate, the upper cleft or lobed and tapering to an elongated serrate apex: rhachis sulcate on face, angled by decurrent pinnæ, bearing in their axils a gemmule covered with minute scales: pinnæ 7–8 to a side, oblong to oblong-lanceolate, acuminate, distantly serrulate, base truncate on upper side and reduced on lower; basal pair stalked, produced, 4½ inches long, 1 inch broad: others a third to a half smaller, adnate, confluent above: veins single, erecto-patent, mostly 1–3-branched, the lowest anterior veinlet soriferous: sori 15–23 to a side, 6–8 lines long, falling short of both midrib and margin, diplazioid chiefly below middle of pinnæ. (Plate II.)—Pansamalá forest, Dept. Alta Verapaz, alt. 4,000 feet, Sept., 1886. (Ex Pl. cit. 850.)

Baltimore, Md.

Notes on Western Umbelliferæ. I.

JOHN M. COULTER AND J. N. ROSE.

In the following notes those specific names are used which are commonly known to collectors.

Podosciadium Gray has been rather remarkable on account of its poor representation in herbaria, and the restricted range of its species. Curiously enough, both of these things have come from a strange confounding of its species with those of Carum, and herbaria are found to be richer in these forms than their labels show, and their range has been very materially extended.

P. Bolanderi Gray has been badly confused with Carum Gairdneri and C. Oreganum by collectors, and under these names it is found in many herbaria. A glance at the conspicuous scarious-bracted involucels, broadly concave seed-face, and numerous oil-ducts, should at once distinguish it from any species of Carum. It is an interesting fact that a species thought to be so local is now found somewhat widely distributed through California and Oregon, having heretofore concealed its identity under a general similarity of habit to Carum. Its reported stations are now as follows: California, Mariposa Trail, Yosemite (*Bolander* 4898, in 1866 and 1873), Big Meadows, Plumas county (*Mrs. R. M. Austin*, in 1880), Emigrant Gap (*M. E. Jones* 3603, in 1882); Oregon, Union county (*Cusick* 1097, in 1883), Stein's Mountain (*Howell*, in 1885).

P. Californicum Gray, thought to be known only from the single collection of Bigelow, made at Knight's Ferry, Stanislaus county, California, in 1853, turns up in the collection of G. R. Vasey (no. 227) from Santa Lucia Mountains, California, July, 1880, having been distributed as Carum Kelloggii.

Musenium Nutt. seems to be British American, extending into the United States along the Rocky Mountains. Few specimens have been collected within our borders, and hence herbarium material is very scanty. Professor Macoun has discovered M. divaricatum and M. trachyspermum to be quite abundant on the great plains of the Northwest Territory, but M. tenuifolium still remains very poorly known, mature fruit of it not yet having been collected.

Peucedanum Canbyi, n. sp. Apparently acaulescent, but with a short underground stem from a thick more or less elongated rootstock which ends in a globose tuber half to an inch in diameter, glabrous, 3 to 8 inches high: leaves ternate-pinnatifid or bipinnate, the ultimate segments small, with 3 to 5 linear-oblong lobes: umbel equally 5 to 10-rayed, with no involucre, and involucels of narrowly linear scarious-margined bractlets; rays 1 or 2 inches long; pedicels 4 to 6 lines long; flowers white: fruit ovate-oblong, glabrous, 4 lines long, 2½ lines broad, with wings about half as broad as body, and filiform dorsal and intermediate ribs; oil-tubes solitary in the intervals (the lateral intervals often with 1 or 2 accessory but shorter ones), 2 to 4 on the commissural side.—High ridges, E. Oregon (*Howell*, in April, 1880, and

May, 1882, as no. 67); Union county (*Cusick* 1010, in 1882 and 1884).—This species has been referred to P. Nevadense, as several other species have been, but always with a doubt. In Howell's distribution it is labeled P. dasycarpum. It has been too often collected in its early condition, before either fruit or leaves had matured, and in this stage has been very puzzling. Mature fruit of Cusick's collecting, in Canby's herbarium, has enabled us to characterize it as quite a distinct species. It belongs to that tuberous-rooted group of which P. farinosum and P. Cous are representatives.

Peucedanum Sandbergii, n. sp. Caulescent, branching at base, an inch or two to a foot high, from an elongated comparatively slender root, rough puberulent: petioles wholly inflated, with a very conspicuous white-scarious margin; leaves ternately or pinnately dissected, the ultimate segments very short linear: umbel very unequally 6 to 15-rayed, with no involucre, and involucels of distinct linear-lanceolate bractlets; rays 1 to 4 inches long; pedicels a line or two long; flowers bright yellow: fruit ovate, puberulent, 2 to 2½ lines long, 1½ lines broad, with very narrow wings, and filiform dorsal and intermediate ribs; oil-tubes 4 to 5 in the intervals, 6 on the commissural side; seed-face plane.—Bare mountain tops, 5,000 feet altitude, along snow-drifts, Kootenai county, N. Idaho (*J. H. Sandberg* 47); Upper Marias Pass, 7,300 feet altitude, N. Montana (*W. M. Canby* 153); North and South Kootenai Passes, British Columbia (*Dawson* 876).—This very distinct alpine species is remarkable for its inflated petioles with very broad glistening scarious margins, which form the most conspicuous feature of the plant. The peduncles are short when the plant first blooms, rising but a few inches above the ground; but they rapidly elongate, becoming as much as a foot high. The fertile rays also are often very much elongated, becoming many times longer than the sterile rays.

Peucedanum Geyeri Watson still remains an almost unknown species, mature fruit not yet having been collected. The species is badly confused by collectors with *P. farinosum* Geyer. It seems to have been the habit of many to lay in a good stock of P. farinosum and then to label half of it P. Geyeri. Specimens of the latter species are very much to be desired.

Peucedanum nudicaule Nutt. This species was first reported by Bradbury and Nuttall from the " high plains, on the upper part of the Missouri, Arkansas, and the Rocky Mountains," and also collected by Lewis and Douglas "on the Oregon." Since that time true P. nudicaule seems to have been lost sight of, until it has now turned up from its original range, in the collections of Canby and Tweedy. The former sends it from Montana and Dakota (no. 152); the latter from the National Park (no. 855). Forms referred to this species are common enough; but we have not yet seen true P. nudicaule away from its original range "on the head-waters of the Missouri, etc." If any one can supply fruiting specimens of the so-called P. nudicaule, which is said to extend as far eastward as Iowa, we would esteem it a favor.

Angelica arguta of Nuttall, reported by him from Vancouver Island, has not been collected since until discovered by Howell in 1882 at the base of Mt. Adams, Washington Territory, and distributed as A. genuflexa; and then in 1886, along Hood river, Oregon, by the same collector, where it had been collected by Henderson (no. 382), in 1884, and also distributed as A. genuflexa. A fruiting head of this species was also sent by Tweedy from the Cascade Mountains, Washington Territory, mixed with his A. genuflexa, no. 280. Curiously enough, last summer's exploration of Vancouver Island by Professor Macoun failed to reveal A. arguta in its original station, but discovered plenty of A. genuflexa.

Angelica Hendersoni, n. sp. Very stout, densely tomentose throughout, especially the whitened lower surfaces of the leaves and the inflorescence: leaves quinate then pinnate; leaflets thick, broadly ovate, 3 to 4 inches long, 2 to 3 inches broad, obtuse, serrate: umbels equally many-rayed, with no involucre, and involucels of numerous linear-acuminate bractlets; rays 1 to 2 inches long; pedicels a line or less long; flowers white: fruit oblong, more or less pubescent, 3 lines long; dorsal and intermediate ribs prominent, lateral wings thick and corky, as broad as body; oil-tubes solitary in the intervals, 2 on the commissural side: seed deeply sulcate beneath the oil-tubes, with plane face.—Bluffs, moistened by sea spray, Ilwaco (Long Beach), Washington Territory, Aug. 5, 1885 (*Henderson* 2158).

Sanicula laciniata Hook. and Arn. is very much confused in herbaria with S. bipinnatifida, a good deal of S. laciniata having been distributed as S. bipinnatifida, as, for instance, Pringle of 1882, and Jones 3149. The palmately parted leaves, spinosely pointed teeth and bractlets, yellow flowers, less prickly fruit, and sulcate involute seed-face of S. laciniata are well set off against the pinnately parted leaves, merely acute or but slightly pointed teeth and bractlets, purple flowers, densely prickly fruit, and broadly concave centrally ridged seed-face of S. bipinnatifida. Nevin and Lyon, in their exploration of San Clemente Island (off S. California), collected S. laciniata with pedicelled fruit, but in every other respect perfectly typical.

Sanicula Howellii, n. sp. Stems coarse, a foot or less high, more or less buried in the sand, bearing tufts of stout, elongated peduncles and leaves: leaves broad and palmately 3-lobed (often much modified by burial in the sand), the divisions rather sharply cut and toothed, the teeth mucronate-tipped: umbels unequally few-rayed, with involucre of a few leaf-like bracts, and involucels of very conspicuous bractlets, sometimes much exceeding the large globose heads of fruit: flowers yellow: fruit short-pedicellate, prickly all over, 1½ to 2 lines long; oil-tubes irregular in number and distribution; seed-face concave.—Sandy shores, Tilamook Bay and Ocean Beach, Oregon, July 15, 1882 (*Howell* 16, *Henderson* 1584); also on Beacon Hill, Victoria, Vancouver Island, May 5, 1887 (*Macoun* 5). This sea-coast species is most nearly related to *S. arctopoides* H. & A., but the habitat of that species, its almost stemless habit, its leaves so laciniately dissected as to appear fringed, its fruit naked at base, and its nearly plane seed-face, are the more marked characters which serve to distinguish it from *S. Howellii*.

Phellopterus littoralis Schmidt, that curious sea-shore species, so much resembling Cymopterus in fruit, has had its range extended beyond the Oregon shores, where it has been collected by Cooper, Howell and Henderson, having been discovered by Professor Macoun in Vancouver Island in 1887.

Pimpinella apiodora Gray, of the Pacific slope, is a great desideratum in herbaria. It seems to be widely distributed enough, but very rarely collected. Specimens of it are very much desired by the writers.

Crawfordsville, Ind.

Notes on Carex. IX.

L. H. BAILEY.

1. **Carex pansa.** One of the *Multifloræ:* extensively creeping by a woody horizontal rootstock 2 to 4 inches deep: culm scabrous above, stiff and erect or nearly so, about a foot high, exceeding the narrow long-pointed stiff and tufted leaves: spikes 6 to 10, ovoid, less than half inch long, dark brown or nearly black when mature, aggregated into an oblong or ovoid loose head an inch or less long: scales thin, very broadly ovate, dark brown with a broad white-hyaline margin, sharply acute or acuminate: perigynium ovate, flat and nerveless on the inner face, rounded and obscurely few-nerved or nerveless on the outer face, contracted into a short but distinct and slender nearly entire beak, becoming nearly black, completely hidden by the scale.—"Very abundant in drifting sand as well as borders of sea estuaries, Clatsop, Oregon, and Ilwaco, Washington Territory," *L. F. Henderson.*—This should be no. 237*a* in my Synopsis; intermediate between the *Multifloræ* and *Fœtidæ.*

2. **C. ablata.**—*C. frigida* of American botanists, not Allioni.—There has always been a doubt as to the proper disposition of the American plant which has been called *C. frigida* All. Mr. Olney first referred it to *C. sempervirens* Vill., which it very much resembles, but from which it is distinguished, among other things, by the notched orifice of the perigynium. The accumulation of considerable material from our western territory, and a fine suite of European specimens obtained through the courtesy of Dr. Christ, of Basel, have enabled me to determine the fact, which I have always suspected, that the American plant is not the same as the European. C. ablata, as I designate the American species, is distinguished from C. frigida chiefly as follows: Culm stiffer and more erect: leaves broader and firmer, usually shining, commonly shorter: staminate spike smaller, nearly sessile: pistillate spikes shorter and thinner, lighter colored, shorter stalked, the upper 2 or 3 usually aggregated and sessile or very nearly so: scales obtuse, usually shorter: perigynium not so long and slender-beaked.

3. **C. grisea** Wahl., emend.—This species presents three well marked forms: the type, a robust leafy plant with large

inflated perigynia, occurring in the most northern states; a more slender form with slimmer pointed perigynia, growing in the middle and southern states; a depauperate form with very short perigynia, found in the southwest. The following characters distinguish these plants:

Type: Stout, leaves broad (¼ inch wide usually): bracts broad and leaf-like, diverging, very much exceeding the culm: spikes heavy: perigynia much inflated, blunt: scale nerved below, cuspidate or muticous, all except the lowest ones shorter than the perigynium. Boott, t. 86.—New England to Michigan and Illinois, and Pennsylvania.

Var. **angustifolia** Boott, Ill. 34, t. 87.—*C. laxiflora* Ell. Sk. Bot. Car. ii, 549. *C. grisea* var. *minor* Olney, Hall's Pl. Tex. 25.—Much more slender, the culms usually weak: leaves scarcely half so wide as in the species, the bracts especially much narrower and shorter, more erect: spikes more slender, appearing two-ranked (in dried specimens at least): perigynium scarcely inflated, trigonous-oblong, bearing a sharp beak-like point: scale nerveless or very nearly so, longer, sharper, and more spreading than in the species.—Southern Ohio, Pennsylvania and New Jersey, southward to Florida and Texas. Common in the middle states. The variety, as outlined here, includes somewhat more than Dr. Boott evidently intended to designate, but there are no characters, so far as I know, which separate the extreme southern very narrow-leaved form from the plants of the central states. It is still a question as to the relationship of this variety with *Carex oligocarpa* Schk.

Var. **globosa.** Usually low (three to eight inches high, varying to over a foot in the more developed forms): spikes few-flowered (often containing only two or three perigynia): perigynium short, inflated, very blunt, nearly globose or somewhat obovate: scales short, not conspicuously cuspidate, or the upper ones wholly muticous.—St. Louis, Mo., *Eggert*, Arkansas, *Hasse* (specimens somewhat intermediate between this and var. angustifolia), Texas, *Neally*.

4. **Carex flava** Linn., emend.—Carex flava is a puzzling species. It varies towards *C. Œderi* Retz, a species which may not be distinct. Yet there appears to be a satisfactory line of demarcation between the two, and a greater accumulation of confusing material must come in before their union can be justified. The essential characters of typical C. flava

are: Plant one to two feet high, having a peculiar yellowish cast which extends to the perigynia: leaves shorter than the culm: bracts long, conspicuously spreading, the lowest much longer than the remaining portion of the culm: spikes borne close together near the top of the culm, sessile (the lowest rarely short-stalked): perigynium bearing a long and slender beak which is very conspicuously reflexed. The essential contrasting characters of C. Œderi are: Plant smaller, greener: leaves equaling or exceeding the culm: bracts strictly erect: spikes much smaller and much more closely aggregated: perigynium conspicuously smaller, the beak short and straight. The spikes often have a whitish cast. C. flava presents two marked varieties. From the type of C. flava, as characterized above, its varieties may be separated as follows:

Var. **recterostrata.** Plant less yellow, or entirely green: spikes more scattered, the lowest two or three inches remote and usually conspicuously stalked: beak shorter, straight or nearly so.—Vancouver Island, *Macoun*, and possibly across the continent. *C. viridula* Boott, Ill. t. 523, may possibly belong here, judging from the spreading bracts, although the perigynia are rather those of C. Œderi. There are no descriptive notes on this plant in the text, but it is said to be figured from Massachusetts specimens. In my own herbarium there are no specimens of this anomalous variety from the eastern states, but specimens which I have seen elsewhere, as I recall them, are probably to be referred here. The plant is not much smaller than the type.

Var. **minor** Townsend, Journ. Bot. xix, 161. Much lower than the species, eight inches or less high, green: leaves proportionately broader, as long as or longer than the culm, which is often not erect: spikes more or less scattered, almost entirely lacking the yellow color of those of the type, the lower one or two conspicuously stalked: beak shorter, straight.—Atco, N. Jersey, *I. C. Martindale*. Introduced? Common in England.

5. **Carex aperta** Boott, emend.—This species was founded upon plants collected by Scouler and Douglas on the Columbia river. The author erected a var. β at the same time that he proposed the species. This variety, founded upon specimens from the far north, was afterwards (Ill. 182) referred by its author to *C. cæspitosa* var. *filifolia* Boott. In the mean

time he had made another var. β (Ill. 132, t. 426), founded upon plants from the eastern United States. This latter variety has ever since been regarded as *C. aperta* Boott, in Gray's Manual and elsewhere, except in the instance of Olney's fascicles, where it was designated as *C. aperta* var. *minor* Olney. As none of the recent collections from Oregon or Washington contain specimens which could be confidently referred to C. aperta, the species has held its place in our eastern flora through sufferance. A recent careful examination of one of Scouler's specimens, which is deposited in herb. Gray, reveals the fact that it is the same as the plant now provisionally known in this country as *C. acuta* var. *prolixa* Hornem. The specimen appears to have been one of the more slender plants of the original collections, judging from the figure in Hook. Fl. Bor.-Am., which figure well represents the robust forms of C. acuta var. prolixa. The plant of the eastern states can not be considered as belonging to the original C. aperta, and I therefore separate it as

C. stricta Lam., var. **decora**.—*C. aperta*, authors, not Boott. *C. aperta* Boott, β, in part, Ill. 132, t. 426. *C. Haydenii* Dew. Sill. Journ. 3d ser. xviii, 103, probably. *C. aperta* var. *minor* Olney, Exsicc. fasc. v. no. 15.—Usually smaller and more slender than the species, the basal sheaths not fibrillose: spikes short (seldom over an inch long), sessile or very nearly so, only very rarely attenuated at the base, spreading, the terminal staminate flowers few: bracts usually conspicuously spreading: scales very sharp, spreading, longer than the perigynium.—From New England to Illinois and Wisconsin; evidently also in Nebraska, Oregon and Washington. Apparently rare.

6. Carex canescens Linn., emend.—There are three marked types of variation in Carex canescens: (1) A slender and reduced form of the species, very common throughout the northern states; (2) a dwarf series with brown or fulvous spikes, subalpine or alpine; (3) a robust and very leafy form in which the spikes are aggregated into a head, the perigynia long-pointed. Singularly enough, the first form has never had a name, although it has passed as var. vitilis and var. alpicola, unless Læstadius' var. subloliacea may be applied to it. It is very doubtful, however, if this var. subloliacea can be legitimately pressed into service for our American plant. Andersson's account of it extends no farther than the fruit and spikes—"spiculis parvis, subglobosis, remotioribus, fructibus margine sublævibus"—and Boott says that it differs from the species only in the small spikes and the smooth perigynium. Boott knew it only as a Lapland plant. Moreover, the very few specimens to which I have had access differ from the species only in the points designated. Our plants, on the contrary, differ from the species in their very slender and lax habit as well as in the characters of perigynium and spikes. I have therefore separated them from the species as an unpublished variety. The second series of variations may all be included under var. *alpicola* Wahl., with the exception of the dubious var. *dubia* Bailey, and the third under var. *polystachya* Boott.

Var. **vulgaris.**—Var. *alpicola* Bailey in part, Proc. Am. Acad. xxii, 143; distrib. Carices, 1886.—Differs from the species in its more slender culm and laxer habit, its small spikes, and usually smaller and spreading perigynia. This variety bears the same relation to C. canescens that var. microstachya bears to C. echinata. Typical C. canescens is a stout plant, with compact spikes one-fourth or three-eighths inch long. Both the species and this variety are characterized by a silvery color of the spikes.—Common throughout the northern states and Canada, to Idaho, and perhaps farther westward.

Var. **alpicola** Wahl. Fl. Lapp. 232.—*C. curta*, var. *brunnescens*, Pers. Syn. ii, 539; *C. Richardii* Michx. Fl. Bor., Am. ii, 170; *C. vitilis* Fries, Mant. iii, 137; *C. canescens*, *β* Torr. Monogr. 393; *C. canescens* var. *sphærostachya* Tuckm. Enum. Meth. 10, 19; *C. Buckleyi* Dew. Sill. Journ. 1st ser. xlviii-143; *C. sphærostachya* Dew. l. c. xlix, 44; *C. canescens* var. *vitilis* Carey, Gray's Man., 2d ed., 514; *C. canescens* var. *brunnescens* Boott, Ill., 220; *C. vitilis* var. *brunnea* Olney, Bot. King's Rep., 364; *C. vitilis* vars. *alpicola* and *sphærostachya* Olney, Exsicc. fasc. v. nos. 3 and 4.—Smaller than the species (seldom much over a foot high), the culm stiff in the alpine forms, more or less slender in the subalpine forms: spikes small and globular or nearly so, well defined, brown or tawny. Varies from the short, stiff and brown alpine forms—the typical var. alpicola—into various lax and paler forms of intermediate regions. --Common on mountains across the continent, reaching as far south as Georgia, and occurring sparingly in intermediate regions along the northern borders of the United States.

7. **C. Deweyana** Schw., var. **sparsiflora.**—*C. Bolanderi* var. *sparsiflora* Olney, Proc. Am. Acad. 1872, 407 (Hall's no. 580). —The most reduced form of C. Deweyana: plant laxer in habit than the type: leaves narrower: spikes smaller: perigynium twice smaller, more or less excurved. This is commonly confounded with forms of C. canescens, with which it was united in my Synopsis, 144. From the small forms of C. canescens this plant is distinguished by its much laxer habit, broader and soft leaves, the culm very weak or often zigzag above, the perigynia much narrower, longer (lanceolate or narrowly ovate-lanceolate), long-pointed, more or less excurved, borne in loose spikes which are generally subtended by a bract.—From Idaho to Oregon and Vancouver Island. *C. Bolanderi* vars. *elongata* and *minor* Olney, l. c., are unimportant forms of *C. Deweyana* var. *Bolanderi* W. Boott.

8. **C. arctata** Boott, var. **Faxoni.**—Spikes shorter than in the species, usually short-peduncled, erect or nearly so, much more densely flowered, part of them usually contiguous at the top of the culm, rendering the shorter staminate spike inconspicuous: perigynium usually much larger.—Sugar Hill, Lisbon, N. H., *Edwin Faxon*, 1887; extreme northern Minnesota, *Bailey*, 1886; northwestern Ontario at Nipigon, *Macoun*, 1884, and Michipicoton, *Geo. Barnston*, 1860.

As Carex arctata is often confounded with C. debilis, it may be well at this place to state the essential points in which it differs from C. debilis: Radical leaves broader and shorter: perigynium shorter (2 lines or less long), abruptly contracted into a beak, abrupt and conspicuously stipitate below, more loosely disposed on the spike and more spreading, scarcely longer than the very sharp or cuspidate scale.

9. **C. rosea.** Schkuhr, var.? **Arkansana.** Differs from the species in its mostly stouter culm, the spikes much larger and more aggregated and subtended by very long (3 to 6 inches) leaf-like bracts with dilated bases, scales broader and conspicuously awn-pointed, perigynium much larger and broader.—Plentiful in the bottom of La Fourche creek, near Little Rock, Ark., growing beneath underbrush where heavy timber has been cut. *Dr. H. E. Hasse.* This plant suggests *C. Muhlenbergii* var. *australis*.

10. **Carex salina** Wahl., var.? **robusta.** Taller and coarser than the species (2 to 3 feet high), the culm spongy at

the base: leaves soft: bracts very leafy, surpassing the culm: spikes heavy, short and thick (an inch or less long usually and one-quarter or one-half inch thick), mostly dense and truncate at the base, somewhat aggregated, the lower short-stalked: scales various, from lanceolate and acute to ovate and obtuse, brown with a white nerve, longer than the thinner nerveless perigynium.—Salt marsh, Vancouver Island, 1887. *Macoun.* A singular plant with very bushy spikes. variable in character. The perigynia are all empty.

11. **Carex Liddoni** Boott, var. **incerta.**—*C. adusta* var. *congesta* W. Boott, Bot. Calif. ii, 238.—Usually lower than the species (about 18 inches high), the culm much more slender: leaves evidently proportionally longer (nearly as long as the culm): heads shorter (three-fourths inch or less long), much more dense: perigynium somewhat smaller, nerveless or very nearly so.—Summit Camp, California, *Kellogg.*

12. **C. Jamesoni** Boott, var. **gracilis.** Differs from the species in its much more slender and flexuose spikes, which are longer peduncled. *C. Jamesoni β* Boott, Ill. 109, t. 335.—The specimen figured and described by Boott is from northern South America. I refer here, with much uncertainty, two specimens collected in southern Mexico in 1853 by Fred. Müller, nos. 1,337 and 1,338. These specimens are much more slender than that figured by Boott, smaller (one and a half to two feet high), leaves narrower, the spikes fewer and rather more slender and the perigynium somewhat excurved. A larger suite of specimens is necessary for a close determination. Müller's 649 is *C. Jamesoni* Boott, t. 334, and no. 1,336 and part of 1,977, the latter from Orizaba, are C. Jamesoni *γ*, tt. 336 and 337. It seems to me that the var. *γ* should be referred to the type.

13. **Carex triceps** Michx., var. **Smithii** Porter in litt.—*C. Smithii* Porter; Olney, Exsicc. fasc. i. no 28.—More slender than the type: whole plant, except the sheaths, glabrous or nearly so: spikes smaller (½ in. or less long by $\frac{3}{16}$ in. wide), the lower one or two usually short-peduncled: perigynium mostly smaller: scales, especially of the staminate portion, commonly shorter, less squarrose and not so sharply pointed.—Southeastern Pennsylvania, southern New Jersey and southward.

14. **Carex lurida×retrorsa.** Distinguished from *C. lurida* Wahl., which parent it most closely resembles, by its straw-

colored perigynia, which are less inflated and much more spreading, standing at nearly right angles to the axis of the spike.—Lansing, Mich. A large clump of this Carex was found growing between clumps of C. lurida and C. retrorsa. Its habit and characters were such as to at once place its hybrid origin beyond a doubt. It also explains certain ambiguous specimens which have been sent me for name—I can not now recall from whom—and which I recollect to have referred to C. lurida. Without an intimate acquaintance with C. lurida this hybrid will not be readily recognized. It is very likely to be mistaken for C. tentaculata. It resembles very closely *C. tentaculata* × *lurida* Bailey (*C. tentaculata* var. *altior* Boott). Infertile.

Agricultural College, Mich.

The distribution of Isoetes.

LUCIEN M. UNDERWOOD.

The species of Isoetes have been neglected by collectors in many localities, so that our knowledge of their distribution is likely to be considerably modified by further discoveries. Forming, as they do, an inconspicuous element in aquatic vegetation and still more rarely seen in marshy places, they are easily passed by unless one is specially searching for them. Their resemblance to sterile aquatic sedges or Juncus increases the probability of their being overlooked. It may be of interest to note something of the distribution and history of our native species during the six years which have passed since the publication of Dr. Engelmann's valuable monograph[1], as well as to note some of the remarkable features of their distribution on other continents. The species were classed by Engelmann as "submerged," "amphibious" and "terrestrial." Baker[2] makes four groups to which similar terms are differently applied, his group "Aquaticæ" including only a part of Engelmann's "submerged" species, his group "Subaquaticæ" including the remainder, together with Engelmann's "amphibious" species, his group "Amphibiæ" including Engelmann's "terrestrial" species, while his group "Terrestres" is limited to two European species whose leaf bases are persistent. Baker enumerates forty-nine species; with two of Dr. Engelmann's species overlooked by him and the two species described below the number is brought up to fifty-three.

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[1] The genus Isoetes in North America. In Trans. *St. Louis Academy of Science* iv, 358–390 (1882).

[2] Fern Allies, p. 124 (1887).

Geographically Isoetes has a peculiarly wide distribution; to illustrate its main features we will take the various regions of the world in order, commencing with Europe, where the genus was first known:

I. EUROPE.—The European species are thirteen in number, only excelled by our own continent. The species are as follows:[3]

I. lacustris L. (1)
I. echinospora Dur. (1)
I. Azorica Dur. (1)
I. setacea Bosc. (3)
I. tenuissima Boreau. (3)
I. Boryana Dur. (3)
I. adspersa A. Br. (3)
I. Malinverniana Ces. & DeNot. (3)
I. velata A. Br. (3)
I. dubia Gennari. (3)
I. Tegulensis Gennari. (3)
I. hystrix Bory. (4)
I. Duriæi Bory. (4)

Of the above, two species alone, I. lacustris and I. echinospora, are found in northern Europe, extending to the mountain regions of central Europe;, both, moreover, are found with us. Three others, I. hystrix, I. Duriæi, I. velata, are widely distributed throughout the Mediterranean region from Spain and Algeria to Asia Minor, I. Azorica is confined to the Azores, I. dubia and I. Tegulensis to Sardinia and neighboring islands, I. Malinverniana to Piedmont, and the remaining species to France. In the minor distribution France leads with nine species, the island of Sardinia has five, while England and Sweden have only two each.[4]

II. AFRICA.—From Africa ten species have been reported:

I. Peralderiana Dur. & Let. (3)
I. velata A. Br. (3)
I. adspersa A. Br. (3)
I. hystrix Bory. (4)
I. Duriæi Bory. (4)
I. Natalensis Baker. (3)
I. Welwitschii A. Br. (3)
I. Schweinfurthii A. Br. (3)
I. æquinoctialis Welw. (3)
I. nigritiana A. Br. (3)

Of these, the first five are found only in Algeria, the first alone being peculiar to that country; the second is found also in France, and the remaining three belong to the Mediterranean region generally. The last five form the proper African flora, and are distributed from the Niger region to Natal. With such a wide distribution of the few known species it will be surprising if the interior of the Dark Continent does not yield a harvest of new forms.

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[3] The numbers following the species refer to Baker's groups in the order named above.

[4] I. hystrix is recorded from Guernsey, which is botanically a part of France, though politically of England.

III. ASIA.—From Asia we have the smallest number from any continent except South America, which has the same number—six. Of these, only three are peculiar to Asia. The species are:

I. velata A. Br. (3)
I. hystrix Bory. (4)
I. Duriæi Bory. (4)
I. Olympica A. Br. (3)
I. Japonica A. Br. (3)
I. Coromandeliana L. (3)

The first three have already been discussed as Mediterranean; of the remainder, the first is from Asia Minor, the second from Japan, and the third from India; illustrating again the wide distribution of the genus.

IV. AUSTRALASIA has eight species, as follows:

I. Gunnii A. Br. (1)
I. elatior F. M. (1)
I. Stuartii A. Br. (1)
I. Kirkii A. Br. (2)
I. alpina Kirk. (2)
I. Muelleri A. Br. (2)
I. Drummondii A. Br. (2)
I. tripus A. Br. (3)

Here again we have a singular example of wide distribution: the first three are from Tasmania, I. Kirkii and I. alpina are from New Zealand, I. Muelleri is from Queensland, and the last two are from West Australia.

V. SOUTH AMERICA.—From America south of the isthmus of Panama we have the six following species:

I. triquetra A. Br. (1)
I. Lechleri Mett. (1)
I. Savatieri Franchet. (3)
I. Martii A. Br. (3)
I. Amazonica A. Br. (3)
I. Gardeneriana Kze. (3)

Of these, the first two are from the high Andes of Peru, the third is from Patagonia, and the remainder are from Brazil.

VI. NORTH AMERICA.—Coming lastly to our own country, we find the largest representation of Isoetes anywhere found. Nineteen species occur within the limits of North America, including a single species from the West Indies. Of these, only the first two are found elsewhere. Omitting varieties, we have:

I. lacustris L. (1)
I. echinospora Dur. (1)
I. pygmæa Engelm. (1)
I. Bolanderi Engelm. (2)
I. Tuckermani A. Br. (2)
I. saccharata Engelm. (2;
I. riparia Engelm (2)
I. melanospora Engelm. (2)
I. Engelmanni A. Br. (3)
I. Howellii Engelm. (3)
I. nuda Engelm. (3)
I. flaccida Shuttleworth.,(3)
I. Suksdorfii Baker. (3)
I. Cubana Engelm. (3)
I. Mexicana n. sp. (3)
I. melanopoda J. Gay. (3)
I. maritima n. sp. (3)
I. Butleri Engelm. (3)
I. Nuttallii Engelm. (3)

The distribution of most of these species has been discussed by Dr. Engelmann, but as his paper may not be generally known a few details may be referred to here. Most of the above species have a comparatively narrow range. I. Tuckermani, I. saccharata and I. riparia are confined to the northeastern border; I. pygmæa, I. maritima, I. Howellii, I nuda, I. Nuttallii and I. Suksdorfii inhabit the Pacific border only; while Georgia with I. melanospora, Florida with I. flaccida, Cuba with I. Cubana, and Mexico with I. Mexicana, each yields a single species. On the other hand, I. Engelmanni ranges from New England to the Mississippi valley, and I. Butleri and I. melanopoda inhabit the interior, the former ranging from Tennessee to the Indian Territory, and the latter from Illinois to Texas. As I. lacustris and I. echinospora doubtless range over most of the northern half of the continent, the latter extending even to Greenland, a wider distribution of a genus could scarcely be imagined. Turning to individual states, we find a remarkable paucity of species everywhere. The published state lists consulted give species rarely and in many instances add the significant "rare" or "local" to the species given. Of ten state and local floras examined at random from our numerous publications of that character, one, that of Missouri (*Tracy*), gives two species; three, Iowa (*Arthur*), Illinois (*Patterson*) and Ohio (*Beardslee*), give one each; while the other six, North Carolina (*Curtiss*), Minnesota (*Upham*), Michigan (*Wheeler* and *Smith*), Wisconsin (*Lapham*), Indiana (*Coulter* and *Barnes*) and Washington (*Ward*) do not record a single species. Massachusetts, however, has five species, Pennsylvania and New Jersey four each, and New York, California and Oregon three each.[5] Dr. Engelmann's first prophecy, that other species "are expected to be found when the attention of collectors is more earnestly directed to them," finds a double fulfillment in the efforts of two veteran collectors,

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[5] *Cf.* Engelmann, *loc. cit.*, p. 376.

Pringle in Mexico, and Macoun in Vancouver Island. His second prophecy, that "some of the apparently local species will yet be found in a more extended area," depends largely on the activity of collectors in the field.

Some general conclusions may be drawn from the above notes on geographic distribution:

1. The genus Isoetes has a world-wide distribution, being represented not only on every continent, but in almost every part of every continent.
2. While the range of the genus is world-wide, the range of most of the species is remarkably narrow. Excepting the two boreal species, I. lacustris and I. echinospora, and the three Mediterranean species, I. velata, I. hystrix and I. Duriæi, the remaining species are largely local, many being known from a single locality.
3. France for Europe and Massachusetts for America present the largest number of species and varieties, owing, doubtless, to the fact that their collectors have been more active and watchful for these inconspicuous plants.
4. No center of distribution seems apparent; we are unable to assign headquarters for the genus.
5. As we approach tropical regions from both north and south we find a decrease of aquatic and subaquatic forms and a corresponding growth of amphibious, pseudo-terrestrial and terrestrial forms.[6]
6. Probabilities derived from a study of distribution point not only toward a much wider range for individual species, but also to the discovery of many more species as collectors turn their attention to them.
7. As is true of numerous other aquatic plants, waterfowl have doubtless been responsible for the wide distribution of certain species, notably I. lacustris and I. echinospora, which, no doubt, encircle the northern hemisphere.

We add the descriptions of two new species:

Isoetes Mexicana. Amphibious: rootstock two-lobed: leaves 20–30, bright green, 12–22 cm. long; stomata numerous: sporangia oval, 5 mm. long, 3 mm. wide, delicate, unspotted; velum very narrow, almost wanting: ligule triangular, two-thirds as long as the sporangium: macrospores chalky-white, 0.25–0.375 mm. thick, nearly smooth, the three converging ridges in strong relief: microspores slate-colored, 0.028–0.033 mm. thick, mostly smooth.

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[6] It should be noted that the two apparent exceptions to this law, I. triquetra and I. Lechleri, though found in equatorial regions, are both high mountain forms.

Slow streams, base of Sierra Madre, state of Chihuahua, Mexico, October, 1887 (*C. G. Pringle*, no. 1447).

This species is the first that has yet appeared within the limits of Mexico. Mr. Pringle writes: "The Isoetes was found in several different stations, in the shallows of slow rills of the sandy plains about the continental divide, at an elevation of 6,000 to 7,000 feet, and growing as well in the wet sand as in the bottom of pools. Its leaves—what the specimens scarcely show since they were dried—were sinuous and channeled above."

Isoetes maritima. Amphibious or mostly terrestrial: rootstock small, only slightly bilobed: leaves 8–15, rigid, green, 2–5 cm. long, 1.5 mm. wide with abundant stomata: sporangia oval 4 mm. long, 2.5 mm. wide, brownish-white, covered one-third to one-half by the velum: ligule small, inconspicuous: macrospores 0.42–0.48 mm. thick, densely spinulose, the spines somewhat blunt, but rarely confluent: microspores white, smooth, 0.032–0.035 mm. thick.

Salt marsh, Alberni, Vancouver Island, August, 1887 (*J. Macoun*).[7]

This species, next to I. pygmæa, is the smallest of our flora; it differs from all our other pseudo-terrestrial species except I. Nuttallii in being monœcious as well as by other marked characters; from I. Nuttallii it differs by its size, its partial velum and the sculpture of its spores.

Syracuse, N. Y.

BRIEFER ARTICLES.

Lichens from the Easter Islands.—During the year 1885 the United States steamer "Mohican," commanded by Lt. B. F. Day, stopped for some time at these isolated islands for the purpose of procuring some of the famous stone idols which were left by the aborigines. Several fine examples were obtained, and are now on exhibition in the United States National Museum. When these images arrived they were thickly covered with a growth of lichens and a single species of moss. Mr. Henry Willey kindly determined the lichens as closely as their fragmentary condition would permit, finding *Usnea barbata* (L.) Fr., *Physcia stellaris* L., and a sterile Parmelia nearest to *Parmelia lævigata* (Sm.) Nyl. The moss is without fruit, but seems to be a species of Hypnum.—F. H. KNOWLTON, *U. S. National Museum.*

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[7] With this species Prof. Macoun sends from his collection in Vancouver Island I. Nuttallii, extending the range of that species northward from Oregon, and two forms which I have referred provisionally to I. echinospora, though both differ somewhat from any described form of that species. The habits of the two were different, one coming from fresh water (Sproat Lake) and the other "between tides, in flowing water."

Notes on some Illinois grapes.—The following notes were made upon the grapes of Wabash county, Illinois:

1. *Vitis palmata* Vahl. In bloom, July 1 to 10; fruit ripe, after October 1; odor, delicately fragrant; habitat, borders of muddy ponds in bottom lands. Berries have a pleasant taste; not so sour as either of our other wild grapes. Cultivation might produce a valuable fruit. The largest vine I have seen is 1½ inches in diameter, ascending a tree 18 feet. It usually forms large dense mats over the tops of low bushes and sedges. etc. Its common associates are Cephalanthus occidentalis, Populus heterophylla, Gleditschia monosperma, etc. Peduncles sometimes 6 inches long; often throwing themselves around twigs, thus serving as tendrils.

2. *V. riparia* Michx. In bloom, May 10 to 20; fruit ripe, July 10 to 30; odor, slightly fragrant; habitat, along banks of large streams in bottom lands. Vine seldom 3 inches in diameter; straggling over small trees, forming dense overhanging canopies; rarely rising above 50 feet.

3. *V. cordifolia* Michx. In bloom, May 25 to June 10; fruit ripe, after October 1; odor, very fragrant; habitat, throughout river bottoms. This is our largest grape-vine. I have found it 6 inches in diameter, and ascending more than 125 feet.

4. *V. cinerea* Engelm. In bloom, June 15 to 30; fruit ripe, after September 15; odor, delicately fragrant; habitat, along small streams in uplands and barrens. It is very close to V. æstivalis; the foliage of the two can not, in many cases, be distinguished; but the difference in the time at which the flowering and ripening of fruit occur in the two species, together with the long lax bunches, smaller and bloomless berries of V. cinerea, makes a plain, specific distinction between these two plants.

5. *V. æstivalis* Michx. In bloom, June 8 to 20; fruit ripe, after September 1; odor, mildly fragrant; habitat, uplands and barrens.

6. *V. indivisa* Willd. In bloom, June 18 to 28; fruit ripe, after October 1; odor, unpleasant; habitat, throughout river bottoms.—J. SCHNECK, *Mt. Carmel, Ills.*

Prunus pumila in North Carolina.—In "Gray's Manual" it is stated that the range of this species of Prunus is from "Massachusetts northward to Wisconsin, and south to Virginia along the mountains." It is not mentioned in Chapman's "Flora of the Southern United States," nor in the Rev. M. A. Curtis' "Catalogue of the Indigenous and Naturalized Plants of the State of North Carolina." I have, however, found it growing luxuriantly and in quantities on rocks in Henderson county. This county is situated in the alpine region of North Carolina, and from its altitude its flora resembles, in many respects, the flora of a higher latitude. A specimen of the Prunus pumila found in this locality was sent to Dr. N. L. Britton, of Columbia College, N. Y., for comparison with the specimens in the college herbarium. Upon making the comparison he writes: "The Prunus pumila sent I can not distinguish from northern specimens, New York and New Jersey."—EDWARD READ MEMMINGER, *Flat Rock, N. C.*

Synopsis of the genus Panicum Linn.—The species of the United States may be divided into the following sections:

Section I. DIGITARIA. Panicles of several spikes or spike-like branches, which are digitate or approximate at the top of the culm: spikelets usually small and in alternate pairs along one side of the flattened rhachis, one sessile and one shortly pedicelled; empty glumes 2, or sometimes 3, the lower one then being minute.

Species 4.

Section II. TRICHACHNE. Spikelets densely silky-hairy, or fringed with long hairs, sessile or shortly pedicelled, in pairs or clustered along the rhachis of the numerous simple spikes or branches of the panicle, acute; lower glume minute.

PP. leucophæum HBK., *lachnanthum* Torr.

Section III. BRACHIARIA. Panicle subspicate or with several short sessile simple branches: spikelets sessile or subsessile.

1. *Paspaloidea.* Panicle of few (3 to 6) simple, mostly sessile, spreading branches, the spikelets sessile in two rows on one side of a flattened rhachis, as in Paspalum, but with a small lower glume.

PP. platyphyllum Munro, *plantagineum* Link.

2. *Subspicata.* Panicle linear or narrow, the branches short, sessile, erect or appressed, or the apex spicate.

*Branches densely flowered.

PP. paspaloides, Curtisii, obtusum, reticulatum, Texanum.

**Branches lax flowered.

PP. Chapmani, Reverchoni, subspicatum, stenodes.

3. *Approximata.* Branches erect or somewhat spreading (not appressed), mostly approximate.

PP. prostratum, cæspitosum, fasciculatum, grossarium.

4. *Polystachya.* Branches of the panicle numerous, spreading, single or subfasciculate, simple or with short branchlets at the base: spikelets sessile.

PP. pilosum, laxum, barbinode, and small forms of *anceps.*

Section IV. EUPANICUM. Branches of the panicle more or less subdivided, single or fascicled, usually spreading and naked below; spikelets subsessile or pedicelled, sometimes glomerate.

1. Panicle narrow, depauperate; branches few, erect.

PP. xanthophysum, depauperatum, angustifolium Chapm.

2. Panicle small but diffuse, branches rather few-flowered and short.

PP. scoparium, consanguineum, laxiflorum, dichotomum, and related forms.

3. Panicle small or large, branches long: spikelets scattered or glomerate.

PP. gymnocarpon, hians, barbinode, laxum.

4. Panicle larger, branches subdivided: spikelets pedicelled.

PP. latifolium, clandestinum, viscidum, scabriusculum, commutatum, Nealleyi, microcarpon and var.

5. Panicle effuse, branches capillary and much subdivided.

PP. capillare, proliferum, Hallii, autumnale, Buckleyi, miliacea, verrucosum.

6 Tall grasses, with ample and diffuse panicle.

PP. anceps, agrostoides, virgatum, amarum, maximum, bulbosum, avenaceum, Havardii.

7. Frutescent: spikelets large and turgid; empty glumes loose.

P. divaricatum Linn.

8. Panicle diffuse: spikelets large; the glumes very silky-villose.

P. Urvilleanum Kth.—DR. GEORGE VASEY, *Washington, D. C.*

EDITORIAL.

WHAT are the duties of the new experiment stations established at the state agricultural colleges by the national government, and recently made operative by congressional appropriation? The stations have two functions, as laid down by the law—"acquiring and diffusing" knowledge—and it is well to notice the significant order in which they are mentioned. The second section of the act specifies in what lines acquisition may be made, and it is our present purpose only to call attention to that part which relates to the study of plants. "It shall be the object and duty of said experiment stations," so the law reads, "to conduct original researches or verify experiments on the physiology of plants and animals, the diseases to which they are severally subject, with remedies for the same," etc. It can not be wholly accidental that the important subject of vegetable physiology, a subject in which barely a trace of experimental work has yet been done in this country. was placed first in the enumeration. Then comes pathology of plants, in which some progress has been made by American students, both being coupled with similar investigations for animals. Few indications more clearly show the rapid advancement of botany in public estimation than this prominence of the subject in a legislative movement for the improvement of a great industry. Indeed, the law gives more latitude for botanical work than appears at first sight. Of the ten specifically mentioned subjects for investigation, nine give the opportunity for a well educated botanist of the modern school to do good and lasting work, the only non-botanical subject being "the analysis of soils and water," although if hard driven we might insist that nothing prevents interpreting this to mean not only chemical but biological analysis. Thus, the law permits and makes prominent mention of the study of plants in their manifold relations to economic problems, and it remains to be seen if those who carry out its provisions will act as wisely in this regard as the framers of the law have done. No station can give facilities for the pursuance of every line of work contemplated by the law, and those that do a few things well are likely to work more good for the country and bring more credit to themselves than those that scatter their resources among many subjects. Of the things to be done well, the broad and fertile fields of vegetable physiology, pathology and bacteriology offer great expectations of economic and scientific gain to the stations and men who enter them fully equipped for research, and through them to the people at large.

OPEN LETTERS.

Typha.

I am surprised that Mr. Morong, in his interesting article on Typha, in the *Bull. Tor. Bot. Club*, p. 4, 1888, does not mention, under the heading of *uses*, the use of the leaves of these plants in cooperage. In some localities the collecting of these leaves is quite an industry. They are collected, dried in the shade, bound into bundles, and sent to market. When used they are split in halves through the broad diameter, and placed between the joints of headings, and of the staves near the headings. I find, on inquiry, that this is the almost universal method for making tightwork, not only in this country but also in Europe. J. SCHNECK.

Mt. Carmel, Ill.

An odd fuchsia.

A malformed fuchsia which came under my notice a few days ago has five stamens, two of which have become adnate to the pistil. The petals are purple, five in number, and apparently normal. The calyx consists of five sepals, and what is the limb in the normal flower has partially grown together. Fast to this limb, by one edge, have grown two bodies, apparently bracts. In each one the side which adheres is red, like the calyx, while the free half is green and sparingly serrate. At first I thought these bodies were sepals, but as they could be traced to the pedicel of the flower by a prominent line or ridge, I concluded them to be bracts. W. A. PUCHNER.

Chicago, Ill.

Fragrance of flowers.

In regard to the effects of the fragrance of certain flowers upon certain people, of which I have observed several communications in the GAZETTE, I have never been able to sit in a room where lilacs form a bouquet, nor could I ever examine the flowers of the common milkweed, which grows so plentifully along the country roadsides. I have tried many times when a young girl student, and in mature life, endeavoring to persuade myself that I could if I would, but the odor of both lilac and milkweed seems to place a band about my head, which, as regards the lilac, is bearable to a certain limit of politeness, if I am a guest in a house; but the effect of the milkweed is so intensified that I think I should lose consciousness if I persisted long in the inhalation. JULIA S. HOAG.

Albany, N. Y.

Revision of N. Am. species of Fissidens.

On comparing the measurements of leaf-cells and spores in the species treated in my paper (this journal xii, 1887, p. 1) with those recently given by Limpricht,[1] I found mine so uniformly in excess that I was lead to re-examine the matter. As this remeasurement led to the same result as at first, I turned to a verification of the value assigned to the divisions of the eye-piece micrometer used. This value I found had been erroneously determined, being twenty-five per cent. greater than it should be. Those who have occasion to use these measurements are, therefore, requested to deduct one-fourth from them, *e. g.*, 20μ should read 15μ; 24μ should be 18μ, and so on. C. R. BARNES.

Madison, Wis., March 1, 1888.

An exchange herbarium.

An ideal botanical exchange is one through which one can obtain at any time any plant desired. At the New York meeting of the A. A. A S. the Botanical Club appointed a committee, consisting of Dr. Geo. Vasey, Dr. N. L. Britton, Thomas Morong, Dr. S. Watson and Dr. B. D. Halsted, to consider the question of a botanical exchange for this country, and to organize one if thought desirable and practicable. Suggestions from each member of the committee have been secured, as well as from other botanists, and information has been obtained in regard to the Botanical Exchange Club of the British Islands. Direct information regarding a very successful German botanical exchange has for some reason failed to reach the committee, but some account of its methods of work has been learned from persons in this country who have obtained plants through it. An account of the workings of the British Exchange, together with suggestions for the management of one in this country, is given in the February numbers of the *Torrey Bulletin* and BOTANICAL GAZETTE

There is a desire on the part of many that the exchange be located at Washington. The botanist of the Department of Agriculture has, therefore, consented to manage the exchange if so desired, and the Commissioner of Agriculture has granted space in the department building for the purposes of the exchange, and authorized the use of the duplicates belonging to the department herbarium. If the proposed exchange is organized on this basis, it will be practically an extension of the system of distribution heretofore carried on by the Department of Agriculture, and its management under special rules. In this case there would be no fees, and the interchange of specimens would be made through the mails free of postage. Persons desiring specimens could therefore be expected to contribute a liberal number in exchange for those desired, and thus quickly establish a stock from which nearly everything called for could be furnished. The stock of duplicates belonging to the Department of Agriculture has during the past winter been labeled and arranged in botanical order, and now represents nearly 1,000 genera, being especially full in grasses and plants of the southwest.

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[1] Die Laubmoose (Rabenh. Krypt.-Flora), p. 427 et seq.

Many names are being received of persons desiring to join an exchange. To these and others the rules will be sent when the exchange is organized. Persons interested are requested to correspond with the chairman of the committee, Dr. George Vasey, Department of Agriculture, Washington, D. C. A. A. CROZIER.

Washington, D. C.

Alexipharmics.

When reading the article on alexipharmics, or snake-bite antidotes, in the recent number of the *Annals of Botany*, I felt a little surprise at the small number of plants mentioned. I had a vague notion that the list of American species of reputed potency might be increased. This led me to make out, as near as I could recall them, a list of such plants as had some reference to snakes in their names. I am surprised to find in my private library (I have not consulted the large college collection) how little reference there is to the origin of the names. In many cases I am in doubt whether the title has reference to medicinal qualities or external resemblances. Even Darlington and Wood, usually rather expansive on such matters, are singularly silent. Down south, where, it is said, the natives hunt all day for a snake in order to take the remedial tincture there may be more knowledge on the subject. Here is the list for what it is worth:

Actæa spicata, both varieties, snake-root; Eryngium yuccæfolium, rattlesnake master; Sanicula Canadensis, black snakeroot; Eupatorium ageratoides, white snakeroot; Liatris, various species, button snakeroot; Hieracium venosum, rattlesnake-weed; Asarum Canadense, Canada snakeroot; Aristolochia serpentaria, Virginia snakeroot; Goodyera, two species, rattlesnake-plantain; Glyceria Canadensis, rattlesnake-grass; Botrychium Virginicum, rattlesnake-fern.

In Lindley's Medical Botany (1838) the name "rattlesnake-master" is applied to Liatris squarrosa, with the note that it is so called in the southern part of America, and "in case of being bitten by this animal (the rattlesnake) they bruise the roots and apply them to the wound, while at the same time the patient drinks a decoction of it in milk." He speaks of three species of Mikania so employed, but ours is not among them. Has it value?

In regard to Aristolochia serpentaria, Flückiger and Hanbury say, "Its ancient reputation for the cure of snake-bites is now disregarded."

I think it would be interesting to more than myself if some competent person would give us an authentic list of all reputed alexipharmics, and also what is known of the origin of such ophidian names as the above.

Brown University, Providence, R. I. W. WHITMAN BAILEY.

Strawberry poisoning.

In response to my note upon this subject in the January GAZETTE, I have received a communication from Dr. C. F. Millspaugh, of Waverly, N. Y., calling my attention to a number of cases similar to those recorded by myself, which had already been observed and published. The earliest of these cases is attributed to Linnæus, 1757, who mentions in an essay upon the strawberry the poisonous effects of the fruit, and states the chief symptom to be an eruption of the skin. Four other cases of the kind are recorded by later European writers. In all the common symptom is an eruption of the skin with a greater or less swelling of the body; but the cases differ quite materially in other respects, especially as regards the severity of the attack and the suffering of the patient. All of these foreign cases, I believe, are recorded in Allen's Encyclopedia of Pure Materia Medica. On this side of the Atlantic the only case recorded previous to those mentioned by myself, so far as I know, is a very interesting one which came under Dr. Millspaugh's personal observation in his own practice, and is noted in Millspaugh's American Medicinal Plants, Fascicle III, p. 55.

One very important difference between the six cases here alluded to and those mentioned by myself in the January GAZETTE is worthy of special note, namely, that whereas in the former, so far as stated, the poisoning always resulted from eating the fruit, in the latter the mere inhalation of the odor of the ripe fruit might, and in many instances did, cause the poisoning, without tasting or even seeing the fruit itself.

Cornell University. A. N. PRENTISS.

In the BOTANICAL GAZETTE of January, 1888, Prof. A. N. Prentiss, of Cornell University, refers to two interesting cases of strawberry poisoning, and states that they are the only instances of which he has ever known.

Since this particular idiosyncrasy is so rare, I will furnish additional testimony in regard to a cousin of mine, formerly resident in Glens Falls, N. Y., now deceased. She had never manifested fondness for strawberries, but when about four years of age she was urged to eat some, and soon after became violently ill, the illness assuming the form of deathly stupor. Two physicians were hastily summoned, who concurred in pronouncing it a case of vegetable poison. One of them went out into the garden to find what there was to tempt the child, and, returning, said he saw nothing there but strawberries which would produce such results, and they were poisonous to his wife. The other physician said the symptoms were those described in medical books as resultant from eating that fruit, but he had never met with a case in his practice before. The conclusion was reached that the child was the victim of the strawberries of which she had been urged to partake. She naturally refrained from their use afterward, but I remember her mention of a brief but severe sickness once afterward from eating some cream which had been thrown over strawberries. Her sister informs me that later in life she would occasionally taste them without experiencing ill effects. JULIA S. HOAG.

Albany, N. Y.

CURRENT LITERATURE.

A manual of the British Discomycetes.[1]

This is the title of a book of over 400 pages, giving descriptions, synonyms and bibliographic and exsiccatæ references for all the fungi belonging to this family and hitherto found in Britain. Its design is, in the words of its author, "to provide the English student with the means of acquiring a knowledge of the Discomycetes of Britain." But it will be found scarcely less useful to American students, since a very large number of the species described in it occur in this country also. In it are descriptions of nine orders, forty-nine genera, and about 600 species. The descriptions happily include the spore characters, and they are also made more complete by the addition of the habitat, and the derivation of the specific name. Under each genus and sub-genus is an analytical table of the arrangement of the species, and a "key to the species," which will greatly facilitate and simplify the labors of the student.

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[1] PHILLIPS, WILLIAM.—A manual of the British Discomycetes. International Scientific Series, Vol. LXI. 410 pp., 12 plates, 8 vo.

The systematic arrangement is greatly in advance of that of the older manuals, the species included in Peziza and Helotium, in the "Handbook of British Fungi," being here distributed in a dozen genera and twenty-nine sub genera. A spirit of conservatism, however, runs through these changes, and the spore characters have not been given that value in the arrangement which will probably be ascribed to them by Professor Saccardo in his "Sylloge." Each genus is illustrated by figures of one or more of its species, the whole making twelve fine lithographic plates. A glossary of terms, a list of authors quoted, and a very complete alphabetical index, complete the volume. It is a most desirable acquisition to our mycological literature, and will, no doubt, fulfill the author's design in its publication, and give a fresh impetus to the study of the fungi of which it treats, not only in Britain, but also in this country.

CHAS. H. PECK.

Engelmann's works.[1]

Mr. Henry Shaw has put the botanical fraternity under lasting obligations to him in the magnificent book lying before us. The writings of Dr. Engelmann were so much scattered, and at the same time so important, that something like this seemed necessary. It is Mr. Shaw's third munificent gift to botany, following closely upon that of the botanic garden and the School of Botany which bear his name. The work of editing must have been exceedingly laborious, and Dr. Trelease deserves his share of our gratitude. The preface is written by Dr. Gray, and his counsel runs all through the book. A fine portrait of Dr. Engelmann and a biographical sketch fitly introduce the work. Many of the plates had to be retouched, and some of them copied, but every one able to do anything gave his assistance, and the result is something for botanists to rejoice over. The edition is limited to 250 copies, of which one-half are for presentation. The remainder will be sold in sheets, probably at $10 a copy. This is a fitting memorial of one of our most distinguished botanists, and it augurs well for the future of botany in America that it can find such friends to further its interests.

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[1] The botanical works of the late George Engelmann, collected for Henry Shaw, Esq. Edited by William Trelease and Asa Gray. 548 pp., 102 plates, 4to. Cambridge, Mass.: John Wilson & Son.

Plant distribution.

The foundation for the study of geographical botany seems to have been laid by Humboldt and Bonpland's "Essai sur la Géographie des Plantes," bearing the date of 1805. Since that time it has received considerable attention from very distinguised botanists, the bibliography of the subject showing such names as the DeCandolles, Robert Brown, Watson, Darwin, Hooker, and our lamented countryman, Prof. Gray. Probably Dr. Gray's most brilliant production was his "Relation of the Japanese flora to that of North America." As fascinating and important as this subject is, the older botanists were necessarily hampered by the dearth of material, but the times are now fast ripening for a study of this great department. The latest presentation of it lies before us in the shape of Drude's[3] eight charts, with descriptive text. He divides the flora of the world into fourteen regions as follows: (1) Northern, (2) Central Asia, (3) Mediterranean, (4) East Asia, (5) Middle North America, (6) Tropical Africa, (7) East African Islands, (8) Indian, (9) Tropical America, (10) Cape, (11) Australia, (12) New Zealand, (13) Andes, (14) Antarctic. Each of these has its subdivisions. His dealing with the North American flora may be taken as an illustration. Nearly all of the British possessions belong to the first or Arctic group, which also includes the southern shores of the great lakes and New England, and extends down the Appalachian system into North Carolina. Central North America belongs to his fifth group, while Southern Florida and most of Mexico belong to the ninth or Tropical American group, which extends southward so as to include the bulk of South America. As an illustration of the author's subdivisions we may take the Middle North American group, which is nearly coextensive with the United States. The subdivisions are four, viz.: (1) Californian, including the Pacific coast states; (2) Montana, including an area lying chiefly north of the 40th parallel, extending well up into British Columbia, and eastward to Minnesota; (3) North Mexico and Texas, including the areas the name implies and extending north about to the 40th parallel; (4) Virginian, commencing at the west with the prairie region and extending eastward to the Atlantic. It is easy to criticise these details, as, for instance, the boundary line between the second and third subdivisions. It is very apparent to the student of North American botany that the very characteristic Texano-Mexican flora does not extend bodily up to the 40th parallel; but these are details that can hardly be expected to be minutely accurate in such a world-wide presentation of the subject. The charts are most excellently prepared, and, of course, invaluable to any student of geographical botany.

Practical botany.

If there is anything in the so-called "practical botany" it is getting abundant chance to show itself in the numerous laboratory guides. The last one on our table is another translation of Strasburger's "Botanische Practicum,"[4] that is, the abridged edition. In this journal the original German edition, Hillhouse's translation, and the second German edition have already been reviewed, so that nothing remains to be said concerning the subject matter of this admirable book. Two English translations were hardly necessary, and probably two were not contemplated by either translator. The translation before us is well done, but we miss the very useful list of materials needed at the beginning of each study, as well as the full list of reagents used. As for the book itself, the name of the publisher insures a book of such heavy paper and binding and expense as to very materially defeat its purpose of being a laboratory guide.

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[3] DRUDE DR. O.—Atlas der Pflanzenverbreitung. (Berghaus' Physikalischer Atlas, Abtheilung V.) Gotha: Justus Perthes, 1887.

Minor notices.

THE STAINING of living nuclei is one of the latest triumphs of histology, and one that puts the cell activities within comparatively easy reach of observation. In this journal (xii, 40 and 192) Mr. Douglas H. Campbell has already shown some of his results in this direction, and now he has distributed in pamphlet reprint[5] a full account of his experiments, conducted at Tübingen, under the title "The Staining of Living Nuclei."

A PRELIMINARY LIST of the vascular plants of the Lackawanna and Wyoming Valleys, by William R. Dudley, is published in the Proceedings of the Lackawanna Institute of History and Science, volume one The list includes 769 species, and is compiled with the customary care of the author, and is admirably printed.

A VERY BRIEF biographical sketch of Edward Tuckerman was published in this journal shortly after his death,[6] accompanied by a full bibliography of his scientific writings.[7] The National Academy appointed Dr. W. G. Farlow to prepare a memoir of their associate, which has been separately printed.[8] The sketch of Tuckerman's life is admirable—compact and sympathetic. The bibliography adds but two articles to our list, viz.: "Note on Geaster quadrifidus," *Am. Jour. Sci.* xxxvi, 380 (July, 1839), and "Vegetation in the White Mountains," in King's "The White Hills," Boston, 1860. pp. 230–241. Some reference to Mr. Willey's bibliography would not have been out of place.

THE PLANTS which produce burs or other devices for attaching their seeds or seed vessels to the hair or wool of animals, and thus securing distribution, are interesting from several points of view. A good service has been rendered by Dr. Huth in bringing together in one monograph[*] a concise account of the plants having fruit with hooked or barbed prickles or spines. He makes five classes: (a) those in which the roughness also assists the plant in climbing during growth, as the bedstraws; (b) those from which the seeds are projected, as the Martynia and other common kinds in which this property is not always noticed; (c) the rare anchor burs, *e. g.* Trapa natans; (d) the boring fruits, such as Stipa, Erodium and other grasses; and (e) clinging burs, like the stick-tights. Most of the space is devoted to a brief systematic account of all bur-producing plants, 163 genera being mentioned.

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[4] STRASBURGER, DR. EDUARD.—A manual of the microscope in vegetable histology; from the German by Rev. A. B. Hervey. 332 pp., fully illustrated, 8vo. Boston: S. E. Cassino, 1887.

[5] From Untersuchungen aus dem bot. Institut in Tübingen.

[6] Vol. xi, p. 73.

[7] L. c. p. 74, 182.

[8] Memoir of Edward Tuckerman, 1817-1886. Read before the National Academy April, 1887. pp. 14, 8vo. Washington: The National Academy.

NOTES AND NEWS.

"SOME COMMON THISTLES" is the title of an illustrated paper by Prof. L. H. Pammel in *Colman's Rural World* (March 9).

PROFESSOR J. C. LYFORD is giving a course of illustrated botanical lectures before the Worcester (Mass.) Natural History Society.

DR. CHRISTIAN LUERSSEN has been called from the Forest school at Eberswald to be professor of botany and director of the botanic garden at Königsberg.

THE METHOD of bleaching, staining and mounting the unsectioned leaves and sporangia of ferns is described by the careful preparateur, Rev. J. D. King, in the *Microscope* for March.

PROFESSOR BAYLEY BALFOUR has been elected to the chair of botany in Edinburgh University, made vacant by the death of Dr. Dickson. This leaves a vacancy in the botanical department at Oxford.

DR. GRAY'S last writing appears in the *American Journal of Science* for March, being the Botanical Necrology for 1887. The list contains the names of W. E. Tolmie, John Goldie (both of whom died in 1886), Albert Kellogg, William Boott, Ezra Michener, and H. W. Ravenel.

DR. GEORGE L. GOODALE has in the past two months delivered a course of twelve lectures, at the Lowell Institute in Boston, on "Forests and Forest Products." A printed syllabus of each lecture was distributed to the audience. Judging from these synopses and Dr. Goodale's great attractiveness as a lecturer, the course must have been exceedingly interesting.

A PRESUMPTUOUS and unblushingly egotistical article on the germ of the southern cattle plague is given in the March *Microscope* over the signature of Dr. F. K. Billings, "director of the patho-biological laboratory of the State University of Nebraska," laying claim to all honors worth a straw in the study of this subject. If this is the manner in which "the sun of original investigation seems to be rising in the west," we hope for the credit of American science that its rays may be kept under a bushel as much as possible.

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[*] HUTH, DR. ERNST.—Die Klettpflanzen mit besonderer Berucksichtigung ihrer Verbreitung durch Thiere. (Bibliotheca botanica, Heft 9.) 36 pp., 78 wood-cuts, 4°. Cassel: Theodor Fischer, 1887.—4 marks.

THE DANGER of laying too much stress upon spore measurements, particularly in the Agaricini, is dwelt upon by Dr. M. C. Cooke in a somewhat caustic article in *Grevillea* for March. The variability of the spores of the same species, and the considerable difficulty of making accurate measurements, suggest the necessity of giving authority for the same when such data are added to descriptions originally published without them.

DR. J. BRUNCHORST has carefully investigated the potato disease known as "scab" and finds it produced by a Myxomycete, for which he proposes the name *Spongospora Solani*. The plasmodium can be found in the parenchyma cells, which brings about the hypertrophy of these cells, resulting in the formation of the swellings. These pustules subsequently dry up and crack or become brown, thus forming the scab-markings.[1]

IN THE *Revue Bryologique* (no. 1, 1888, p. 2) A. L. Grönvall [illegible] some of the criticisms of Venturi as to the species of Orthotrichum which he described in [illegible]. M. Venturi [illegible] to reduce the number of species by combining the [illegible] [illegible] M. Grönvall [illegible] many of our American species are treated, the paper is worth [illegible] tion of our bryologists.

PNEUMATHODES is the name of certain root organs studied [illegible] L. Jost, found chiefly on certain palms, and discovered to be [illegible] the aeration of the plant. They are outgrowths from the root pointing upward into the air, and are characterized by having a swollen portion different from the rest. Dr. Goodale (*Am. Jour. Sci.*, March, 1888), in commenting on Jost's communication (*Bot. Zeit.*, Sept. 1887), refers the "cypress-knees" to this new class of organs.

THE OFFICE of the seed tuber in the potato plant is treated from experimental evidence by E. S. Goff in *Agricultural Science* for February. His conclusions are that the plant takes up nearly or quite all the available food from the tuber before the latter decays, that such nutriment is better suited to the needs of the young plant than nutriment from the soil, and that the rapidity with which the transfer is made depends upon outside conditions, such, especially, as the condition of the soil.

REV. THOS. MORONG continues his studies in the Typhaceæ in *Bull. Torr. Bot. Club* (March) by presenting our six species of Sparganium. They are *S. eurycarpum* Eng., *S. Greenei* Morong (a new California species), *S. androcladum* Morong (*S. simplex*, var. *androcladum* Eng.) and var. *fluctuans* Morong (*S. simplex*, var. *fluitans* Eng.), *S. simplex* Huds. and vars. *multipedunculata* Morong (a new Montana form) and *angustifolium* Eng., *S. minimum* Bauhin, and *S. hyperboreum* Laest. (from Hudson Bay and Labrador).

PROFESSOR LUNDSTRÖM, of Upsala, has discovered that Melampyrum leaves secrete nectar for the purpose of attracting ants, who in turn carry the seeds of the plant in their mouths down to the ground, as they resemble ant cocoons. So complete is this mimicry that seeds strewed upon the ground were found to be carefully saved by the ants as if they were cocoons. The thin membrane investing the seed, and giving it its cocoon-like appearance, falls off soon after it reaches the ground, after which it remains undisturbed by the ants.

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[1] Abstract in *Bot. Centralblatt*, xxxiii, 309.

Rev. Thomas Morong is going to visit South America, mainly under the auspices of the Torrey Botanical Club. He expects to sail about the first of June for Buenos Ayres, with the purpose of exploring and collecting in the great water system which empties into the Atlantic through the Parana and the Rio de la Plata, and afterward of crossing the Andes by the overland route into Chili. He also hopes to reach Lake Titicaca, in Peru, before returning. The great water systems of South America should be particularly attractive to a student of aquatics.

In the preliminary report which M. Viala has made to the French minister of agriculture upon his six months' stay in this country for the study of American grapes and grape culture, he devotes most space to the range of our native species and their hybrids growing in limestone regions, especially those of the more southern part of the country, and concludes that the most promising for use on the calcareous soils of France are Vitis Berlandieri, V. cinerea, and V. cordifolia. A more extended account of his studies here, including diseases of the grape and other topics, will be published after a time. He speaks warmly of the attention and assistance accorded him by Americans, and particularly by Commissioner Colman and Professor Scribner, of the U. S. Department of Agriculture.

"The Kew of the East" is the designation of the Royal Botanic Garden at Calcutta. In the last annual report (1886-87), being for the 100th year of the garden's existence, a sketch of the history of the institution is given which is also printed in the *Gardeners' Chronicle* (Feb. 18). Some great names in botany appear among its directors, as, for instance, Dr. William Roxburgh, from 1793 to 1814, the father of Indian botany and the author of the Flora Indica; also, Dr. Nathaniel Wallich, from 1816 to 1846, well known for his explorations and extensive distribution of Indian plants; also, Mr. C. B. Clarke, acting director for a time, whose name is very familiar in connection with descriptions of Oriental plants. The present director, Dr. King, is credited with having transformed the garden and brought it up to its present high estate.

The action of frost on seedlings is the subject of some interesting experimental study. "In cold climates the annual period of growth is shortened, the season during which the plant must vegetate is condensed, and the shoots and flowers have to unfold rapidly in order to 'make hay while the sun shines.'"—*Gardeners' Chronicle*, Feb. 25. The following experiment will serve to indicate the work and its results: "Müller-Thurgau took ten potatoes, all alike, and of about the same size and weight. He placed five in an ice-cellar, and surrounded them with ice; the other five were kept in an ordinary house cellar. Those exposed to the freezing process yielded a large crop in three months after planting, while the others, planted at the same time, and in exactly the same way, soil, etc., had as yet only begun to show shoots, and bore no tubers." (l. c.)

The proposed government station for the study and testing of grasses which is projected as an adjunct to the botanical division of the Department of Agriculture is meeting with some opposition. The *Nation* (No. 1,185) contains a three-column argument to show that, while the idea is in itself good, the project is needlessly expensive and hopelessly imperfect. Better results might be accomplished, it believes, by special provision for such work at the various state experiment stations, thus costing less and at the same time giving the advantage of having the work done in the climate and region where the results are to have practical application. Without entering into the discussion, it is safe to affirm that to distribute the proposed work to the state stations, while it has advantages in regard to climate, would, nevertheless, result in leaving the matter in about the same condition as it will be without congressional action.

THE FIRST FOUR numbers of *Garden and Forest*, the new horticultural journal, more than fulfill the promise of its announcement. The list of distinguished contributors is already a long one; it includes Mrs. Schuyler Van Rensselaer, on landscape gardening; Francis Parkman, B. E. Fernow, J. Hoopes, Robert Douglas, on forestry and tree growing; Peter Henderson, John Thorpe, William Falconer, A. H. Fewkes, on gardening and floriculture; a number of foreign contributers and the following well known botanists: Dr. Sereno Watson, Dr. W. G. Farlow, Dr. Wm. Trelease, Dr. W. J. Beal, Dr. G. L. Goodale, Prof. L. H. Bailey, Jr., A. A. Crozier and C. G. Pringle. The typography and printing, together with the character of the illustrations, far surpass any horticultural achievement of the kind before attempted in this country, The opening article is a tribute to the memory of Dr. Gray, and the second number has an admirable photogravure of the bronze medallion of Dr. Gray by A. St. Gaudens. There is also an account of the life of Dr. DeBary. The form and scope of the journal call to mind the *Gardeners' Chronicle* of England, and we can make no higher wish than that in stability and influence it may equal its esteemed contemporary across the water.

AN ILLUSTRATED WORK on the British Uredineæ and Ustilagineæ, by Charles B Plowright, F. L. S., is projected. It is to contain descriptions of all British species of these fungi, and also an account of their biology, including the methods of experimental culture. The work must prove of great service to students, especially as it is prepared by an authority so justly famous for the success of his experimental methods. The determination of the genetic connection between the forms of heterœcismal rusts is a fascinating study that can be carried on with simple appliances, and this book will be a boon to isolated botanists with inclinations toward original investigation. The publishers, Kegan Paul, Trench & Co., London, will begin the printing as soon as the requisite number of subscribers is obtained. Intending purchasers should at once send their names to the author (7 King St., King's Lynn, England). The price will be 7s 6d, or about $1.90, to subscribers, payable upon delivery, or 10s 6d, about $2.65, to non-subscribers.

A VERY appreciative editorial notice of Dr. Gray appears in *Gardeners' Chronicle* (Feb. 4), one or two passages from which we quote: "Apart from his scientific eminence, the clear-headed, genial character of the man endeared him to all with whom he came in contact. His vast knowledge, his untiring industry, his singleness of aim, his keen discrimination, his unselfish pursuit of science, his eminently judicial qualities, caused him to be respected even by those who exposed themselves to the sharp rapiers of his polished criticism." "No one on this side of the Atlantic thought of Asa Gray as an American cousin— he was here always a brother Englishman." "Asa Gray, as will be judged from his books and memoirs, was no dry-as-dust student of dried plants; their life-history and the working of their mechanism had a charm for him, and no man was happier than he in popularizing, in the best sense of the term, the discoveries of the science, and creating an interest in them among the general public." "America had no truer son than he; philosophy no more noble prophet. All honor to his memory, deep gratitude for his work and his example."

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Notes on North American Willows, with a description of new or imperfectly known species. I.

M. S. BEBB.

Since the publication of the Flora of California, much additional knowledge has been gained concerning American glaucoid willows. The genuine Glaucæ, in their extension southward within the boundary of the United States, are restricted to the Rocky mountains and Wasatch range—in a word, keep east of the Great Basin, with this exception, that on some of the highest peaks of the Sierra Nevada, at altitudes varying from 10,000 to 12,000 feet, a very peculiar form of Salix (glauca) villosa was collected years ago, on Mt. Hoffman and Wood's Peak by Prof. Brewer, on Mt. Whitney by Prof. Rothrock. Upon the evidence afforded by these three collections this species was given a place in the Flora of California, and although ten years have since elapsed they still remain, unsupported by further findings, to attest the occurrence of any form of S. glauca west of the Great Basin. Mr. Watson's no. 1099 (Bot. King Exped. p. 325), from the East Humboldt mountains of Nevada, alt. 9,000 feet, is the same plant.

Taking now the allied forms of the Sierra Nevada and Cascade ranges, we have, first, the well known S. Californica, more clearly distinguished from all forms of the Glaucæ by its glandular-serrulate leaves, green both sides, entire style and entire erect stigmas, than was at first believed. This, so far as known, is peculiar to the Sierra Nevada, and not found beyond the limits of the state for which it is named. Going northward, we next come to a species of the Cascades and Blue mountains, not heretofore recognized, sharing with S. Californica the characters above mentioned, but adding to them several very striking ones verging toward the Cordatæ, viz.: glabrous capsules, shorter style and stigma and very conspicuous stipules. This species finds its easternmost limit on some rugged peaks near Snake river, part of the Idaho system. Finally, this, in turn, is replaced on Mt. Adams by still another species exhibiting a still further approach to the Cordatæ, as I have indicated in the description. This ranges from Mt. Adams far northward, spreading over to the Rocky mountains in Montana, and approximating in character several very diverse northern species.

The geographical distribution of these species in connection with their order of sequence in natural affinity is curious. Even in British Columbia, before the boundary of the United States is reached, it is observed that the Rocky mountains mark the western limit of S. villosa. Prof. Macoun says, "under a number of forms this variety extends from the eastern side of the Rocky mountains at Morley to the summit of the Selkirks (51°) and northwestward"[1]—that is, along the trend of the mountains. It follows the mountains southward also, spreads over the Wasatch range, and then skipping from peak to peak, as it were, finds a rare lodgment on a few of the highest summits of the Sierra Nevada. Has this any significance, in connection with the strange fact that in the group which we have been considering as restricted to the mountains west of the Great Basin, a group intermediate in character between the Glaucæ and the Cordatæ, *it is at the south that the variation toward S. glauca occurs and at the north the transition toward S. cordata?*

Taking S. commutata as combining in the most remarkable manner glauca-like and cordata-like characteristics, we must apparently trace its connection with S. glauca southward around the southern extremity of, or by leaps across, the Great Basin, and thence northward along the Rocky mountains to Alaska, while directly northward there is a manifest fading out of glaucoid characteristics and accession of those leading toward S. cordata. And this notwithstanding the fact that genuine S. glauca is found on the coast of Alaska. Between Oregon and Alaska I do not know of a willow so nearly allied to S. glauca as this plant of the Blue mountains and the Cascades.

S. commutata, n. sp. A diffuse alpine shrub of variable stature, commonly 3 to 4 feet in height, in sheltered localities 8 to 10 feet, often much dwarfed by altitude and exposure: leaves broadly oblanceolate or oblong, abruptly pointed, cuspidate, tapering toward the roundish base, at first covered more or less with a dense silky tomentum, downy even when fully grown; older and lower leaves becoming smooth, green both sides (not glaucous beneath), margin entire or (under a lens) minutely glandular-serrulate; leaves of sterile shoots ample, 3 to 4 inches long, varying to cordate-ovate, thinnish in texture; stipules large, ovate, glandular-serrate: aments on stout leafy peduncles with 4 to 7 ovate or oblanceolate leaves, erect, densely flowered, an inch long; fertile in frui 2 inches, compact, cylindrical; scale thin, pale or brownish, obtuse, woolly; capsule ovate-conical, glabrous, greenish or rufescent; pedicel pubescent, 2 to 3 times the length of the nectary; style medium, stigmas small, erect, entire.

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[1] Cat. Canadian Plants, p. 449.

Var. **sericea.** Young leaves densely white tomentose, entire.

Var. **denudata.** Young leaves smooth or nearly so, more distinctly serrulate.

Var. **puberula.** Capsule thinly puberulous. Transition to S. Californica.

Alpine bogs, Eagle Creek mountains near Snake river, in great abundance, also in the Blue mountains, where it appears to be limited to a small district, *Cusick*; Cascade Mts., Washington Territory, alt. 6,400 ft., *Tweedy*. Var. *sericea*, moraines near the snow line on the north side of Mt. Hood, *Howell*, *Henderson*. Var. *denudata*, Eagle creek meadows, *Cusick*; Cascade Mts., Washington Territory, *Tweedy*.

In its glabrous rufescent capsules, entire style and short erect entire stigmas, and in its large serrulate stipules this species obviously resembles S. cordata; while on the other hand the whole habit of the plant, the broad softly tomentose subentire leaves, the stout leafy peduncles and subsessile capsules are like S. glauca.

S. conjuncta, n. sp. Leaves of the flowering branches elliptic or obovate, subacute, 1 to 1½ in. long; leaves of the sterile branches ample, 2 to 4 in. long, 1 to 2 in. wide, ovate-lanceolate, cuspidate-acuminate, attenuate or rounded at base; stipules large, ovate, acute; all glabrous or at first thinly overspread on the upper surface with evanescent floccose hairs, at length rigid, scarcely paler or rarely subglaucous beneath, young drying black, margins finely and evenly crenate-serrulate: aments borne on stout leafy peduncles, large, thick, 1 to 2 in. long; fertile becoming rather loose and flexuose in fruit (lengthening sometimes to 3 in.); scale acutish, dark, villous with crisp hairs, sometimes densely or again thinly hairy or quite naked at the tip; capsule glabrous, rostrate from an ovate base; pedicel 3 times the length of the nectary; style medium or elongated, about equaling the pedicel, stigmas short, entire or bifid.

In wet meadows and along alpine rivulets, Mt. Adams, Washington Territory, *Parry*, *Howell*, *Suksdorf*, *Henderson*; Cascade Mts., alt. 5,500 ft., *Tweedy*; Bald mountain, S. W. Montana, alt. 7–8,000 ft., *Watson*; summit of S. Kootanie pass, B. C., *Dawson;* Kicking Horse pass and on the Selkirks, *Macoun;* near Alaska, *Dawson;* Kodiak, *Kellogg.*

This combines characteristics of several diverse species, while differing from each in turn. It has been mistaken for S. Barrattiana, especially the form with thick woolly aments, but it differs in the smooth leaves, aments peduncled, capsules glabrous: accords in some respects very nearly with the character assigned S. Barclayi—a species of the Alaskan coast—but that has a much longer style and long slender reflexed stigmas: aments as in S. cordata, but leaves broader and shorter, drying black, capsules shorter pediceled; leaves, particularly of the flowering branches, like S. montana of the Rocky mountains, but that has closely sessile aments. The wide range over which this species preserves its character is a guarantee of its validity. On Mt. Adams it appears to replace, as it were, S. commutata, from which it is distinguished by the darker green leaves, often subglaucous beneath, distinctly crenate serrate, smooth (as in S. phylicifolia), drying black, aments more loosely flowered, capsules rostrate, perfectly smooth even to the pedicel, stigmas often bifid.

Rockford, Ill.

Some undescribed Hepaticæ from California.

LUCIEN M. UNDERWOOD.

(WITH PLATES III—VI.)

Among botanical collectors on the Pacific coast, Dr. Henry N. Bolander has done more than all others to bring to light new forms of Hepaticæ, and his name is inseparably connected with species belonging to several genera. Much of the material which he collected was sent to Mr. Austin, who described numerous species from California. Some of his earlier collections, however, were sent to Dr. C. Gottsche in Altona, near Hamburg; among these are some that have never been described; camera tracings of four of these have been at Cambridge for some time. With the kind permission of both Dr. Gottsche and Dr. Watson I am able to publish these plates with the necessary descriptions, as well as the description of a fifth which is not represented in any of the larger herbaria of the country, but of which Dr. Gottsche has generously sent both specimens and a Latin diagnosis. The fact that these species have remained undescribed for twenty-two years is significant, as is also the fact that, so far as known, only one of the species has been collected a second time. The latter circumstance may doubtless be explained on the ground that the original stations are in regions less visited and accessible. There is every reason to believe that many interesting species will be discovered in California, particularly in the mountain regions, and doubtless several of the species now accredited to Oregon alone will be found in northern California.

Of the species described below, four are of the genus Jungermania as limited by modern writers, while the fifth is of the thallose genus Grimaldia.

Jungermania Danicola Gottsche MS. Autoicous: stems small, ascending, simple, sparingly radiculose: leaves rotund, increasing upward, semi-amplexicaul, rather distant, entire: amphigastria wanting: involucral leaves similar to those of the stem: inner involucre[1] obovate, the mouth more or less irregularly bilabiate.

Hab. In ditches, Mt. Dana, California, 10,000 ft., Sept., 1866 (*Bolander*).

PLATE III—I. Plant showing antheridia and archegonia. II. Plant showing young archegonia and a single involucre.[1] III. Inner involucre from the side. All magnified 62 diameters.

Jungermania rubra Gottsche MS. Stems short, creeping, densely radiculose to the apex: leaves subimbricate, bright red, ovate-rotund, oblique, semi-amplexicaul, slightly decurrent dorsally, entire: amphigastria wanting: involucral leaves larger than those of the stem, with thickened margins: inner involucre quadrangular-ovate, the mouth short mucronate, denticulate, ferruginous purple especially toward the apex and the angles: antheridia unknown.

Hab. On metamorphic sandstone, Mendocino City, California (*Bolander*); cliffs near the sea, Santa Cruz, California (*Farlow*).

PLATE IV—Figures all magnified 24 diameters.

Jungermania Bolanderi Gottsche MS. Stems simple ascending, innovating from beneath the involucres: leaves concave, ovate-rotund, entire, closely imbricate, those of the innovations more remote and decurrent, plane, slightly undulate: amphigastria wanting: involucral leaves larger than those of the stem, otherwise similar: inner involucre cylindric-ovate, the mouth entire or slightly denticulate: male plant unknown.

Hab. In ditches, Mt. Dana, California, 10,000 ft., Sept., 1866 (*Bolander*).

PLATE V—I, II, female plants; III-VI, inner involucres; VII, innovating branch; VIII, involucral leaves. All the figures are magnified 17 diameters.

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[1] I follow the nomenclature of my "Descriptive Catalog," and use this term in place of *perianth*.

Jungermania Muelleri, var. **Danaënsis** Gottsche MS. Stems 1–3 cm. long, mostly simple, creeping, ascending at apex, densely radiculose: leaves semi-vertical, irregularly quadrate-rotund, more or less emarginate-bilobed or rarely trilobed, the lobes rounded, the sinus obtuse or rarely acute; areolation mostly uniform, moderately close: amphigastria wanting: involucral leaves half as large as those of the stem, acute or acuminate, more or less irregularly cleft or serrate: inner involucre obovate, irregularly fissured, the mouth multidenticulate: male plant unknown.

Hab. In ditches, Mt. Dana, California, 10,000 ft., Sept., 1866 (*Bolander*).

PLATE VI—I–V, various portions of plant; VI, XI, XII, inner involucres in various positions; VII–X, XIII, XIV, XVI, stem leaves; XV, involucral leaves. All the figures are magnified 20 diameters.

From *J. Muelleri* it is distinguished (1) by the absence of amphigastria, (2) the shape of the inner involucre, and (3) its smaller involucral leaves—characters almost sufficient to be regarded as specific; it may finally take rank as a distinct species. Specimens in the Harvard herbarium are labeled "*J. Danaensis*, *vel J. Muelleri*, var. *Danaensis*."

Grimaldia Californica Gottsche MS.[2] Thallus 1–3 cm. long, 2–4 mm. wide, linear-spatulate, with obcordate innovations, thickly covered underneath with purple scales which extend beyond the margin: peduncles 2–2.5 cm. long, reddish at base, green above, arising laterally from the innovations: carpocephalum globose-conoidal, purplish, 1–4-fruited: capsule reddish; spores black-purple, crenulate; elaters purple.

Hab. Yosemite Valley, California, on rocks in the spray of Bridal Veil Fall, June, 1866 (*Bolander*).

Syracuse University, Syracuse, N. Y.

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[2] With Dr. Gottsche's letter came the following diagnosis: "Capsula (colore vini rubri) purpurascente (luce pervia); sporis nigro-purpureis, margine subtiliter crenulatis ($\frac{1}{222}$); elateribus purpureis (et fibris et utriculo); pedunculus basi rubescente squamis rubro purpureis pallidioribus ornatus, apice viridis ex innovationum cordiformium parvarum lateralium sinu exsurgit; et receptaculum globoso-conicum 1-3-4 carpum habet."

Notes on the Flora of James Bay.

JAMES M. MACOUN.

To the botanist especially interested in the distribution of plants there is perhaps no district which affords better opportunities than James bay for noting the interchange of species. If the coast line be followed, the change is so gradual as one proceeds northward, that a thorough examination day by day of the flora a mile inland from the coast will result in the discovery of but few species that had not been observed before, but it will be seen that the more southern forms are gradually disappearing; along the coast itself northern species become more and more abundant, while the islands a few miles from the shore present a flora that is essentially arctic. When one remembers that many days after the snow has disappeared from the woods huge masses of ice lie piled along the shore, and that long after these have been melted by the warm rays of the June sun other masses, driven by wind and current from the far north, are stranded upon the islands of the bay, it is not difficult to account for the great difference between the species growing on the mainland and on the islands, although the latitude and elevation be the same.

A general description of the flora of James bay would be impossible, as, while the west coast is low and bordered by marshes, the east coast is rocky and much higher, and the immense mud flats of the western and southern shores are entirely wanting. Although the cold currents from the north enter the bay along the western shore, the water is so shallow that floating icebergs, even of small size, ground many miles from land, while on the eastern side of the bay the water is very deep, and the ice is moved here and there by every change of tide. The plants found along the western coast are simply those one expects to find throughout the wooded country of the north, and I shall confine myself to a brief mention of the more interesting species found on the mainland and islands of the eastern portion of the bay, and shall not attempt a general description of its flora, but will take the course northward that was followed last season, and note the more important changes as they occur.

Moose Factory, situated about eight miles from the mouth of Moose river, in lat. 51° 18′, may be taken as a starting point. Were it not that the number of species is smaller, no difference could be seen between the plants growing immediately about this place and those found throughout northern Ontario, and upon descending to the mouth of the river no species were seen that are not common along the Atlantic coast. Sailing in a northeasterly direction a distance of about sixty miles from Moose river, Charlton island is reached, from which the mainland may be seen both toward the south and east, and a very perceptible change is at once noticeable in the character of the flora. The first flower that meets the eye on stepping ashore is *Chrysanthemum arcticum* L. in profusion just below high-water mark, and a few yards higher up *Silene acaulis* L. and *Dryas octopetala* L. var. *integrifolia* Ch. & Scl. growing in tufts side by side, near them *Pedicularis flammea* L., and *Botrychium Lunaria* Swartz. The last mentioned species is very common on all the islands of James bay. On the wooded portion of Charlton island the species are almost identical with those noted at Moose Factory, but on the higher almost barren ground of the interior but few species grow, and these are mostly northern, among them *Campanula rotundifolia* L. var. *arctica* Lange, generally with white flowers, the beautiful pink-flowered form of *Achillæa millefolium* L., *Potentilla maculata* Pour., *Salix arctica* Pall., *Salix reticulata* L. and *Poa cenisia* All. A peculiar form of *Linum perenne* L. with white flowers is common on this and the other islands in James bay. I have never seen a blue-flowered specimen growing anywhere near James bay or Hudson bay, although I have collected this form as far north as lat. 56° on the west coast of Hudson bay; in habit, also, it is quite distinct from the western form of this species which I have; growing in sand just above high-water mark, it stretches itself along the ground, but is never erect as on the plains.

Crossing to the mainland and sailing north about 140 miles, Big river (lat. 53° 50′) is reached, and here a number of interesting species were collected, among them *Festuca ovina* L. var. *brevifolia* Wats., *Glyceria maritima* Wahl., *Deyeuxia Langsdorffii* Kunth, *Phleum alpinum* L., *Hierochloa alpina* R. & S., *Deschampsia atropurpurea* Scheele. var. *minor* Vasey (new var.), and a new species of Deyeuxia not yet described. In the pond along the borders of which this last mentioned species grew *Sparganium hyperboreum* Loest. was very abundant, although not seen in any other locality. *Juncus filiformis* L., *J. Balticus* Deth. and *J. triglumis* L. were all very common here, and *Luzula arcuata* Meyer and

L. spicata Desv. were by no means rare. The sand and gravel bars at the mouth of the river were covered with *Chrysanthemum arcticum* L. and *Matricaria inodora* L. The only ferns growing in this locality were *Botrychium Lunaria* Swartz, *B. ternatum* Swartz and *Aspidium spinulosum* Swartz, var. *dilatatum* Hornm.

About sixty miles southwest of the mouth of Big river lie two islands, "The Twins" (between lat. 53° 5′ and 53° 20′), each about thirty miles in circumference. These islands are quite barren, with the exception of a few stunted spruce trees. On the northern island there are perhaps not more than a score of these, and none of them are above six feet in height. Although low and spreading, they were of mature age and covered with cones, settling beyond a doubt that *Picea alba* Link goes farther north than *P. nigra* Link, on James bay at least. Around all ponds on these islands *Salix glauca* L. was very abundant, and on the north Twin island specimens of a new willow were collected which has been described by Mr. Bebb. While all the northern plants that had been seen before were found on these islands, many additional species were noted, principally endogens. *Carex rotundata* Wahl., *C. microglochin* Wahl., *C. rariflora* Smith and *C. nardina* Fries were the most interesting carices collected. *Potamogeton pectinatus* L. was common in all ponds, and about a dozen specimens in all of the rare *P. rutilus* Wolfg. were secured, one or two at a time. The usual form of *Epilobium latifolium* L. is quite common all around the bay, and on the south Twin island three specimens were collected with much larger flowers of a beautiful cream color, and with a delicate but perceptible odor. *Bartsia alpina* L., *Pedicularis Lapponica* L., *Erigeron uniflorus* L., *Arabis humifusa* var. *pubescens* Wat. and *Stellaria longipes* Goldie var. *Edwardsii* T. & G. were collected together on the first dry ground above high-water mark, while in the interior of the islands *Saxifraga Hirculus* L., *Saxifraga aizoides* L., *Pedicularis hirsuta* L. and *Luzula comosa* Meyer were frequently met with. On a grassy bank, by the only spring noticed on either island, grew *Veronica alpina* L., *Sibbaldia procumbens* L., *Ranunculus affinis* R. Br. var. *validus* Gray and *Parnassia Kotzebuei* Cham. & Sch., and these species were not seen in any other locality.

Although the exploration was carried on as far north as Cape Jones in lat. 54° 30′, no species were seen there that did not grow on the islands further south.

Of the three hundred or more species of flowering plants found growing around James bay I have mentioned only those that I considered the most interesting, but I do not doubt that future explorations will add many additional species to the list.

Ottawa, Canada.

Jacob Whitman Bailey.[1]

STANLEY COULTER.

No sketch of North American botany would be complete were the name of Professor Bailey omitted. The record of his life and work is a record not only of interest, but of inspiration and encouragement to all botanists, in that it shows how great results may be attained, in spite of what to many might have seemed insuperable obstacles.

Jacob Whitman Bailey was born in the old town of Ward (now Auburn), Worcester county, Mass., on the 29th of April, 1811. In his boyhood he gave evidence of a taste for scientific studies, leaving the companionship and sports of those of his own age for solitary wanderings through the woods—not the mere purposeless excursions of boys, but for the collection of plants and minerals, which he afterward classified. This scientific taste seems to have come to him by direct inheritance from both branches of the ancestral line, his great-grandmother Whitman being especially distinguished for her love of botany and astronomy. Even as a boy was manifested that rare and beautiful modesty which characterized his after life. He worked and studied that he might satisfy himself, not that he might distinguish himself or surpass his schoolmates. Owing to the limited resources of the family, he was, at the age of twelve, placed in a circulating library and book store in Providence. In this position he found much time for self-improvement, devoting himself especially to the study of mineralogy and conchology. So earnestly studious was he that he attracted the attention of Mr. John Kingsberry, long secretary of Brown University, who, knowing the difficulties under which he was laboring, invited him to spend certain evenings of the week at his home for the purpose of studying Latin. The remaining evenings of the week the boy spent in the study of French with a French teacher. It is a little surprising to learn that he also found time to make a very considerable collection of shells and insects. This habit of making every moment of the day productive became even stronger as he grew in years, and serves to explain how he was able to accomplish what seemed to be impossibilities.

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[1] The data for this sketch were furnished by Prof. W. W. Bailey, of Brown University from letters of his father in his possession and from his personal reminiscences.

In July, 1828, he received an appointment as cadet at West Point, from which school he graduated fifth in his class in 1832.

After serving at various posts as second lieutenant of artillery, he was, in March, 1834, appointed assistant professor of chemistry at West Point, an occupation far more congenial to one of his studious tastes. In July, 1838, he writes to his brother, informing him of his appointment as professor in charge of the newly constituted department of chemistry, mineralogy and geology. This position he retained to the time of his death, the 27th of February, 1857.

Before passing to an examination of his scientific work, it is but proper to refer to the great tragedy of his life and that which cast a shadow over his later years. He was married in 1835 to Miss Maria Slaughter, of West View, Virginia, and from the glimpses of their after life which we have been permitted to have, the home thus founded must have been one of unusual happiness. In July, 1852, Prof. Bailey, his wife, his only daughter and son Whitman (Prof. W. W. Bailey) were passengers on the steamer Henry Clay, which was burned near Yonkers. When the fire broke out Prof. Bailey succeeded in lowering his wife and daughter into the water, and had just received from them assurances of their safety, when suddenly a cloud of smoke mingled with sheets of flame shut them from his view and they were lost. His son was saved almost as by miracle. Previous to this he had been subject to bronchial affections, and his exertions on this occasion, added to the bitterness of his bereavement, gave him a shock from which he never rallied.

Singularly modest, reserved in manner except to those to whom he had given his friendship, bright and sparkling in conversation with the few chosen ones, of rich poetic taste and fancy, strong in his hate of the wrong, tender and loving in his home—these were his personal traits, and these are traits that make rare men.

Among the earlier scientific passions of Prof. Bailey was that for botany, and throughout his life, even though the duties of his chair would seem to have left but little time for outside work, he continued its study. Scarcely one of his sketches of his numerous exploring trips but that shows the hand of the trained and accurate botanist. But it was through his work with the microscope, and as a direct result of his knowledge and mastery of it, that he was to win for himself a distinctive place in the botanical world and become "the Ehrenberg of America."[2] The first purchase he made for himself as a boy was that of a microscope, and from that time a microscope was the constant companion of his journeys. His improvements of its mechanism, his suggestions as to its appliances, have placed all microscopists under obligations to him. His observations were characterized by accuracy and completeness, and his skill with the pencil, added to his habit of making copious notes, furnished him ample data for all subsequent papers.

In 1839 his work upon the diatoms commenced. He was led to this study by the appearance of an object in the field of his glass that he did not fully understand. His attention having been thus attracted, he devoted himself with wonderful zeal to a study of those life forms grouped under the general term infusoria, and soon added to this a study of the algæ, a branch requiring almost as much patience and microscopic skill as the former. When he commenced these studies nothing had been done in this country, and books could not be procured. Gradually, as he worked, he collected the literature of the subject, added to it the result of his own labors, became the active correspondent of Ehrenberg, Kützing, Agardh, and a score of others, and won the high position he holds in these lines of research.

In the pursuit of these studies materials were secured from all possible sources, and worked with astonishing fidelity and skill when we consider their quantity. His bequest to the Boston Society of Natural History included 550 slides, upon which were mounted over 3,000 objects, together with 32 portfolios of algæ, containing some 4,500 specimens.

Prof. Bailey also made a special study of raphides, the results of which were published in 1843 in *Silliman's Journal*, under the title, "On crystals which occur spontaneously formed in the tissues of plants," and are still authority upon the subject. In 1846 Prof. Bailey published in the same journal a paper "On the detection of spirally-dotted or scalariform ducts and other vegetable tissues in anthracite coal," which brought new honor to the unassuming worker. His papers are quite numerous, and are characterized by a terse and direct simplicity that evidences a complete mastery of the subject in hand. Dr. Gray says of them: "They are all clear, explicit and unpretending as they are thorough; and every one of them embodies some direct and positive contribution to science." The majority of these papers, being published in *Silliman's Journal*, are of such easy access that an extended notice of them in this place is unnecessary. Some of the more general sketches, such as the one entitled "Account of an excursion to Mount Katahdin, in Maine," serve to show the wide reach of his knowledge and the grace of his style to a greater degree, perhaps, than his more strictly scientific papers. Omitting all titles, except those pertaining more or less directly to botany, the following list will enable us to appreciate somewhat not only the character of his work, but his wonderful industry. Yet, to fully realize the magnitude of his achievements, it must be remembered that his was the work of breaking paths in hitherto untrodden regions; that he worked virtually without assistance, without literature, without appliances, save those his own ingenuity devised; that, while thus working, he was also filling with distinction his chair in the Military Academy at West Point, and making an equal fame in other branches of scientific research. In the Synoptical Flora, Dr. Gray calls him "The pioneer in microscopical research in the United States;" and yet, with all his duties, with all this new world to explore, he found leisure to draw hundreds of carefully finished sketches of knights and ladies, castles and palaces, for the amusement of his invalid son. The titles here given are taken from the catalogue of the Royal Society, and were furnished by his son, Prof. W. W. Bailey, of Brown University:

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[2] Dr. A. A. Gould in Proc. Bost. Soc. Nat. Hist. vol. VI, p. 174.

Account of an excursion to Mount Katahdin, in Maine.—*Silliman's Journal*, XXXII (1837), 20–34.

Observations on the vascular system of ferns and notice of a monstrous flower of Orchis spectabilis.—*Silliman's Journal*, XXXV (1839), 113–117.

On fossil infusoria discovered in peat earth at West Point, New York, with some notices of American species of Diatomæ.—*Silliman's Journal*, XXXV (1839), 118–124.

A sketch of the infusoria of the family Bacillaria, with some account of the most interesting species which have been discovered in the United

States.—*Silliman's Journal*, XLI (1841), 284–305; XLII (1842), 88–105; XLIII (1842), 321–332; American Geol. and Nat. Assoc. Repts. (1843), 112–164.

American Polythalmia from the Upper Mississippi, and also from the cretaceous formations on the Upper Missouri.—*Silliman's Journal*, XLI (1841), 400–401.

Yellow showers of pollen.—*Silliman's Journal*, XLII (1842), 195–197.

Notes on the infusoria of the Mississippi river.—Proceedings Boston Soc. Nat. Hist., II (1845–48). 33–35.

Notice of some new localities of infusoria, fossil and recent.—*Silliman's Journal*, XLVIII (1845), 321–343.

On the crystals which occur spontaneously formed in the tissues of plants [1843].—*Silliman's Journal*, XLVIII (1845), 17–32; Bibl. Univ. LVI (1845), 388-392; Froriep Notizen, XXXV (1845), col. 65-69.

On the detection of spirally dotted or scalariform ducts and other vegetable tissues in anthracite coal.—*Silliman's Journal*, I (1846), 407–410; Ann. Nat. Hist., XVIII (1846), 67–69.

Account of some new infusorial forms discovered in the fossil infusoria from Petersburg, Va., and Piscataway, Md.—*Silliman's Journal*, XLVI (1844), 137–142.

On some new species of American Desmidiaceæ from the Catskill mountains.—*Silliman's Journal*, I (1846), 126–127.

Notes on the algæ of the United States.—*Silliman's Journal*, III (1847), 80–86, 399–403; VI (1848), 37–42.

On a process for detecting the remains of infusoria, etc., in sedimentary deposits.—Proceedings Amer. Assoc. 1849, 409.

Some remarks on the Navicula Spencerii, and on a still more difficult test object.—*Silliman's Journal*, VII (1849), 265–270.

Discovery of an infusorial stratum in Florida.—*Silliman's Journal*, X (1850), 282.

Reply to Mr. de la Rue's remarks on the Navicula Spencerii contained in the *American Journal of Science*, vol. IX, p. 28: with a notice of two new test objects.—*Silliman's Journal*, 1851, 82–84.

Microscopical observations made in South Carolina, Georgia and Florida [1850].—Smithsonian Contributions, II (1851).

Microscopical examination of soundings made by the U. S. Coast Survey off the Atlantic coast of the United States.—Smithsonian Contributions, II (1851); *Edinburgh New Phil. Journal*, LI (1851), 359-361; LIV (1853), 142–144; *Silliman's Journal*, XII (1851), 132-133; *Journal Micro. Sci.*, III (1855), 89-91.

List of Diatomaceæ collected by the United States Exploring Expedition under Captain Wilkes.—Proc. Philadelphia Acad. Nat. Sci., VI (1852-53), 431-434.

Observations on a newly discovered animalcule.—*Silliman's Journal*, XV (1853), 341-347; *Journal Micros. Sci.*, I (1853), 295-299.

On a mode of giving permanent flexibility to brittle specimens in botany and zoölogy.—*Silliman's Journal*, XVIII (1854), 100–102; Ann. Nat. Hist., XIV (1854), 373–375.

Reply to some remarks by Mr. W. H. Wenham and notice of a new locality of a microscopic test object.—*Silliman's Journal*, XIX (1853), 28–30.

On a universal indicator for microscopes.—*Silliman's Journal*, XX (1855), 58-65; *Journal Micros. Sci.*, IV (1856), 55–62.

Notes on new species and localities of microscopical organisms [1853].—Smithsonian Contributions, VII (1855).

Remarks on Mr. Wenham's paper on aperture of object glasses.—*Silliman's Journal*, XXI (1856), 105-106; *Journal Micros. Sci.*, IV (1856), 160–162.

New method of detecting fossil Diatomaceæ.—*Silliman's Journal*, XXI (1856), 356–357.

On the non-existence of polarizing silica in the organic kingdom.—*Silliman's Journal*, XXI (1856), 357-358; Ann. Nat. Hist., XXIII (1856), 78–79; *Journal Micros. Sci.*, IV (1856), 303–305.

On some specimens of deep sea bottom from the sea of Kamtschatka.—*Silliman's Journal*, XXI (1856), 284–285.

Notice of microscopic forms found in the soundings of the sea of Kamtschatka.—*Silliman's Journal*, XXII (1856), 1–6.

On the origin of green sand and its formation in the oceans of the present epoch.—*Silliman's Journal*, XXII (1856), 280-284; Ann. Nat. Hist., XVIII (1856). 425-428; Proc. Boston Soc. Nat. Hist., V (1854–56), 364–368; *Journal Micros. Sci.*, V (1857), 83–87.

Report upon the result of microscopic examination of soundings made by Lieut. Berryman, of the U. S. Navy, on his recent voyages to and from Ireland in the "Arctic."—*Silliman's Journal*, XXIII (1857), 153-157.

The breadth and accuracy of Prof. Bailey's knowledge are manifest in all of these papers. A few of the titles seemingly foreign to any line of botanical research have been introduced because of the many references contained in the papers which they represent to work done in that direction. Many titles have been omitted altogether, because they only served to give evidence of his ability in the fields of chemistry and geology, and have no place in a sketch of the botanist, unless it be to increase our admiration for the scientist whose strength of mind and keenness of vision enabled him to be both deep and broad.

His work gained for him many tokens of honor and respect from his fellow-workers. At the time of his death he held the position of president of the American Association, and had he lived would have presided at the Montreal meeting of 1857. Many species were dedicated to him, and a genus of the Compositæ commemorates his name. I extract the following from Plantæ Fendlerianæ, at page 105, as a fitting conclusion to this brief sketch, giving, as it does, the testimony of Dr. Gray as to the work and merit of Prof. Bailey. Dedicating Baileya, a new Composite genus of two species from the Texano-Arkansas district, he says: "This genus is dedicated to Prof. J. W. Bailey, of the U. S. Military Academy, who is particularly distinguished for his researches among the minuter algæ and especially the Diatomaceæ (which he was the first to detect in a fossil state in this country), for his microscopical investigations concerning the crystals contained in the tissues of plants, and for the detection of vegetable structure in the ashes of anthracite."

Purdue University, Lafayette, Ind.

A new water-lily.

THOMAS MORONG.

(WITH PLATE VII.)

Castalia Leibergi[1] n. sp. A diminutive water-lily with white odorless flowers about 1½ inches in diameter when fully expanded: sepals an inch long, narrowly obtuse, the nerves on the inner side very obscure: petals in two rows, a little shorter and more obtuse than the sepals, faintly striped with purple lines: stamens in 3 or 4 rows, running up the ovary slightly more than half-way: stigmatic rays 7 or 8, the projecting points very short and blunt: leaves oblong or oval, with a broad open sinus and obtuse lobes, varying in size from 2 to 4 inches long by 1¼ to 2½ inches wide, the veins on the lower surface sunken: petioles and peduncles smooth: rhizome and fruit not seen.

Judging from the length of stems on the specimens examined, the plant must grow in shallow water. It bears much resemblance to *Castalia pygmæa* Salisb., a plant found in Siberia, China and Japan, but that has still smaller flowers, with acute sepals and petals, lobes of the leaves acute, and, according to Aiton, sunken veins in both surfaces of the leaf.

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[1] The writer is aware that in the present dispute regarding the nomenclature of our water-lilies he is likely to have his property appropriated by the other side whether he adopts the name in the text or calls the plant *Nymphæa Leibergi*, but believing in the "right of priority," both as to generic and specific names, he prefers to follow his own convictions of justice rather than ask which is the larger party in the controversy, or which carries the greater weight of authority.

This pretty little addition to our water-lilies was collected by Mr. John B. Leiberg, June, 1887, in a small pond in northern Idaho, near Granite station, on the North Pacific Railway; "very local," as the collector writes, and the first of the genus discovered so far west.

Ashland, Mass.

BRIEFER ARTICLES.

A meeting of the German botanical society.--Among the numerous scientific societies of Germany the Deutsche botanische Gesellschaft holds a prominent place, and as the German botanical society *par excellence* it very properly has its headquarters in Berlin, where there are probably more botanists of reputation than any other city in the world can show.

The meetings are held in the botanical institute, which at present occupies a building immediately back of the university. On entering the lecture-room in which the members are assembled, we find it a most unpretending room, furnished in the most primitive style with clumsy wooden benches and desks that have evidently seen many generations of students, as is plain from the innumerable inscriptions and devices cut or scrawled upon them, for in this particular students are much the same on both sides of the Atlantic. At the front of the room, on a low platform, were chairs and desks for the chairman and secretary.

The meeting was called to order at about half-past six by Professor Schwendener. He is a man of about sixty, but does not look so old, being noticeably vigorous in appearance. He is of medium height, with a scholarly face framed in abundant, rather short iron-gray hair and beard.

The first thing on the programme was the election of members, and the proposing of new names.

Before proceeding to the business of the evening Professor Schwendener announced the death of three members, DeBary, Cienkowsky and Dr. Kroh, the latter name a new one to me. He dwelt especially upon the irreparable loss that science had suffered in the death of DeBary, and the very high position he held, not only as an investigator, but as a teacher. No botanist had had so many distinguished pupils, and no teacher was ever more looked up to. After concluding his remarks, all present rose in respect to the memory of the departed members.

The greater part of the meeting was occupied in the reading of abstracts of papers; the authors, when present, reading themselves, in other cases the reading being done by some other member. Among the papers read was one by Tschirch on the development of resin-passages and similar secretion-reservoirs, which he illustrated by blackboard drawings. Professor Magnus read abstracts of two papers, one by Reinke on the brown algæ of the bay of Kiel, and another very interesting one by Schütt on the nature of phycoerythrin. Professor Kny spoke briefly of a paper by Dr. Müller (his assistant), who was unable to be present, on secretion-canals in the phloem of certain Umbelliferæ and Araliaceæ. There were other papers more or less interesting, but this will give some idea of their general character.

Among those present I noticed Professors Schwendener, Kny, Ascherson, Magnus, Wittmack, Frank, Drs. Tschirch, Potonié, Schumann, and numerous others whom I did not recognize. Pringsheim, who I believe is the president of the society, was not present, though I saw him at an earlier meeting. The ladies were represented by Miss Hallowell, of Wellesley, who at the urgent invitation of several members was present, and I fancy was about the first woman who has been thus honored, as you probably know the Germans have rather different ideas from ours in regard to the woman question. It was with some difficulty that Miss Hallowell could escape the friendly importunities of one or two of the members, who almost insisted that she should also take part in the supplementary meeting which most of the members held in a neighboring restaurant, where over a glass of beer questions are discussed in a more informal way than in the regular meeting.

Thus ended the January meeting of the Deutsche botanische Gesellschaft.—DOUGLAS H. CAMPBELL, *Berlin.*

Puccinia mirabilissima Pk.—While collecting in several of the western states and territories during the summer of 1887, this species was observed by the writers upon the leaves of Berberis repens in several localities. Not only were the uredo- and teleutospores found, but on several occasions an Æcidium which differs somewhat from the well known Æcidium berberidis was taken upon the same host.

The Æcidium was collected near the head of a small cañon at Flagstaff, Arizona. Although the host plants were plentiful, only an occasional affected leaf could be found. Careful search was made for Puccinia in the same locality, but none was observed. Half a mile distant, in the same cañon, an abundance of Puccinia mirabilissima was collected; the uredo stage being much more abundant than was the teleutoform, the latter being found only on leaves which were apparently two years old, while the former were found upon almost every young leaf examined. Careful search was made here for the Æcidium, but none was found.

On September 27, P. mirabilissima was found very abundantly in a cañon near Golden, Colorado, on its usual host, Berberis repens. The plants appeared thrifty and vigorous, but nearly every leaf was affected, and on many at least half the under surface was covered by the dark brown sori. Hundreds of plants were examined, but not one was found free from the fungus. Care was taken to collect some of the oldest and most mature leaves, as well as some of the younger and fresher ones, but only an occasional teleutospore can be found on any. This, probably, may be accounted for from the fact that the Colorado specimens were taken at a time when they had several weeks more in which to complete their growth before being checked by frost, while the Arizona specimens were taken near the close of the long dry season, when the growth was completed, and the plant in a condition similar to that in which the Colorado plants would be at the beginning of the winter.

Whether this Æcidium is only a form of the well known barberry cluster cups or whether it is related to Puccinia mirabilissima remains to be proved by artificial cultures; we merely mention its occurrence in this connection as an interesting fact.

Our specimens give the following characters: Spots bright purple, 3-4 mm. in diameter, very slightly thickened: æcidia hypogenous, long, pale yellow, borders coarsely lacerated; spores subglobose, tuberculate, 15-20μ in diameter.—TRACY & GALLOWAY, *Washington, D. C.*

Abnormal Anemone and Convolvulus.— A description of two abnormal flowers may be of interest to the readers of the GAZETTE, as bearing upon morphology.

The first was a flower of Anemone dichotoma. Normally there are five white sepals, with an involucre some distance below the flower. This specimen had a sixth sepal outside of the others, but so close as to touch. It differed from the rest in that the upper half had the form and color of an involucral leaf, but much smaller. It was half sepal and half leaf.

In the second case the abnormity was deeper seated. A flower of Convolvulus sepium, the wild morning-glory, had four lobes of its large white corolla perfectly developed, but the fifth was about half as wide as it should be and entirely separate from the others. Four of the stamens were perfect, while the fifth, seemingly anxious to compensate for the imperfection of the corolla, was developed in a curious manner. It was placed opposite the point of detachment of the fifth lobe of the corolla; the filament was about the same length as the others, but broader and channeled. One lobe of the anther was fairly well developed, while the other, which was next to the imperfect corolla lobe, had grown into a petal. This portion, which was the exact color and texture of the corolla, was ¾ inch long, and ¼ inch wide at the top.—A. S. HITCHCOCK, *Iowa City, Iowa.*

A gift to Brown University.—About two years ago it was mentioned that Brown University had the promise of the large and valuable fern collection of the late William Stout, of New York. The promise has been fulfilled by Miss A. A. Stout, who gives the herbarium in the name of her deceased brother, and with the understanding that it shall be made available to students and public alike. A large part of the collection has been carefully mounted by the donor on sheets a good deal larger than usual (an advantage, perhaps, with ferns). In most cases there is much duplication, and generous display of material to illustrate geographical distribution. The collection is cosmopolitan. The following items give some idea of the scope of the bequest: Canada to Florida, New Mexico, Arizona and California (565 sheets); India and South India (537 sheets); Ceylon (228 species, 267 sheets); Jamaica (200 species); Trinidad (146 species); Sandwich Islands (100 species); New Zealand (nearly complete collection); New Caledonia, South Africa, Pacific islands and Madagascar (all very complete). Besides these, there are the herbaria of W. T. Atkinson (570 sheets, mostly North Indian ferns) and Dr. A. P. Garber (Phanerogams of Florida, 340 species). A valuable set of books, comprising the best of fern literature, also accompanies the plants.

It will thus be seen that Brown University acquires a collection of ferns almost as valuable as its fine set of Carices.—W. W. BAILEY, *Brown University.*

Death from eating Cicuta maculata.—Ann Arbor, Michigan, adds another to the already considerable list of poisonings due to this virulent plant. The mild days of last week melted the snow, brought back the birds, and induced a general spring-time feeling, to which the children of a neighborhood on the outskirts of the city gave expression by digging and eating the artichokes that occur plentifully on some low ground bordering a brook. Two of these boys were soon taken violently ill, and the son of Julius Krueger, who was eight years old, died within an hour. The violent convulsions, marked dilation of the pupils, and other symptoms indicated some active vegetable poison. Search where the children had been digging brought to light a few suspicious branching tubers, somewhat resembling small dahlias. Their taste was quite suggestive of parsnips, and not particularly disagreeable at first, although less mild than artichoke. On cross section a yellow oily or resinous fluid exuded from a ring of glands in the cortex. No last year's stems could be found, but from the habit of growth, odor, taste, and general appearance of the tubers, and from some nascent leaves on the crown, there was little doubt to what plant they should be referred. A portion of the contents of the stomach of the dead boy afterward came into my possession, and microscopic examination showed the macerated fragments to be identical in structure with the tubers. Finally, an histological comparison with some dried tubers of Cicuta maculata preserved in the university herbarium completed the identification.

The extreme virulence of the poison may be inferred from the comparatively small amount of the tuber found in the stomach on *post-mortem*, and from the fact that the stronger boy, who vomited and recovered, suffered from intermittent spasms more than four hours.—ERWIN F. SMITH, *Bot. Laboratory, Univ. of Michigan.*

An exchange club for Thallophytes.—The following official communication was received too late for the April number. It was sent in response to a suggestion by the editors of this journal that the arrangements being made to establish a botanical exchange club might well be extended to include the lower orders of plants, or else a similar but independent organization might be effected for that purpose, greatly to the advantage and convenience of many botanists:

> SIRS: I am authorized by the Commissioner of Agriculture to say that the same arrangements made with the committee of the A. A. A. S. Botanical Club for facilitating exchanges of plants may be extended to include the thallophytes.
>
> I shall take pleasure in carrying out the purposes intended.
>
> Very respectfully, F. L. SCRIBNER,
> *Dept. of Agriculture, Section of Veg. Pathology.*
> *Washington, D. C.,* March 31, 1888.

As the letter shows, Commissioner Colman, with much liberality, impartially extends the facilities of his department to further the interests of the several classes of collectors, and Prof. Scribner kindly offers to undertake the same supervision of the thallophytes that Dr. Vasey gives to the higher plants. It now remains with the botanists of the country to arrange and perfect plans to put the system of exchanges into successful operation.

EDITORIAL.

THE ADVANTAGES of an organization to facilitate the interchange of herbarium specimens are so numerous and so obvious as to require no argument. The wisdom of the Botanical Club of the A. A. A. S. in setting a scheme on foot for supplying the need of American botanists in this respect meets with general favor. Although not so specified in the reports of the club, and of its special committee yet it is evident that only flowering plants and vascular cryptogams were kept in view by the promoters of the plan. The number of collectors and students of fungi in the United States is large, and the advantages of securing systematic exchanges among them are quite as great, if not greater, than among collectors of higher plants. So far as we know, the matter has not been agitated; but, feeling the need of some such facilities ourselves, and thinking others might also, we took the initiative by securing the good offices of Commissioner Colman and Prof. Scribner, as stated in another part of this number. We hope the subject will be discussed by those who are interested, and plans developed for eventually putting the matter into successful operation. Whether it is best to have only one exchange club, to be divided into two sections possibly, or to have independent organizations for the higher and lower plants, must be determined. The lack of a suitable printed check list of thallophytes for use in marking desiderata is an obstacle to be surmounted. The meeting at Cleveland will give a good opportunity for arranging details and perfecting an organization, especially if there has been discussion through the journals in the mean time.

THE PROCESS of imbedding in paraffin seems heretofore to have been looked upon as only suitable for tissues of considerable resistance. In both editions of Strasburger's *Botanisches Practicum* occurs the phrase "für etwas härtere und bedeutend härtere Objecte empfehlen sich .... und Paraffin." As the last edition was issued in 1887, it is not surprising, therefore, that the *Botanisches Centralblatt* published in June of 1887 an article by Dr. Schönland, of Oxford, giving details of a process for imbedding delicate objects in paraffin,[1] for there does not seem to have been any record of success in this direction previously. We have been informed, however (and in response to an inquiry Dr. Farlow confirms the statement), that for two years and a half advanced students in the cryptogamic laboratory at Harvard have successfully applied the zoölogical methods of imbedding to plants. Certainly, no one could have suspected this from the expressions in the papers published by two of these gentlemen. Mr. J. E. Humphrey in his paper on Agarum Turneri says:[2] "Although this seems hard treatment [*i. e.*, imbedding in paraffin and mounting in balsam] for an algal tissue, the tough, leathery character of the frond enabled it to withstand well, and very satisfactory results were obtained." In the next paper of the volume cited, "On the Morphology of Ravenelia glandulæformis," by Mr. G. H. Parker, p. 209, we read, "Moreover, the density of the imbedding material [paraffin] was such that it intensified the shriveling" [*i. e.*, the shriveling from drying, *herbarium material* being used].

Certainly, these are not expressions which would encourage one in the attempt to imbed *delicate* tissues! But we are very glad to give credit to these students, who, we are assured, used the process in all essential respects the same as that described in the January GAZETTE so long ago as the winter of 1885–6. Let it be borne in mind, however, that the essential features of Dr. Moll's results are perfect preservation of the protoplasmic contents, absolute freedom from shriveling and perfect penetration of the material by paraffin.

IT IS WITH PLEASURE we note the evident tendency of our systematic work. It is rapidly becoming more and more specialized, and hence is sure to become more and more critical. Not so very long ago, a systematic botanist who made any pretense to distinction was expected to be able to pass an infallible judgment upon any plant from Clematis to Quillwort. Fortunately, this day of smattering seems to be passing away, and systematists, even among phanerogams, are confining their attention more and more to certain groups. The consequence must be a more exhaustive study of these groups, an elaboration of all possible means of classification based upon minute as well as gross structures, a complete disentangling of synonymy, and establishing all claims of priority—in short, that detailed presentation of the subject which is necessary if systematic botany proposes to be a progressive science. Even now manuals are not the work of one man, and they will become less and less so, until the best manual will be a very composite affair in the matter of authorship. It is commonly supposed by the uninitiated that every botanist who is more or less well known can unerringly determine "off-hand" any plant that is presented to him. It would be far more comfortable for some botanists if the "uninitiated" could be made to understand that this is an entirely false supposition. Of course, there is a host of plants that every botanist knows, but such are not the ones most frequently thrust at him. He is called upon to decide upon critical cases—some species, for instance, in a difficult genus of most perplexing species. The confession might as well be made that every botanist, however well-informed, has to "dig out" all such plants from the books, and is in no case ready with an "off hand" opinion except in the group which he may just then be studying. A man may even have written a monograph, but presently he will have to use it in the determination of plants like any one else. There has been an astonishing amount of careless "off-hand" naming done by botanists whose names carry weight, and who blundered for the simple reason that they were not familiar with the subject. Specializing avoids all this, and critical points should always be submitted to some botanist who is paying special attention to the group. A botanist should no sooner think of sending a Composite to a man chiefly familiar with Carex than a zoölogist now thinks of sending a Sea-urchin to a specialist in Crustacea.

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[1] See abstract in this journal, xii (1887), p. 172.

[2] On the Anatomy and Development of Agarum Turneri.—Proc. Am. Acad., 1886, p. 202.

OPEN LETTERS.

Is the strawberry poisonous?

In reference to Prof. Prentiss' "open letter" under the above title (this volume, p. 19), the cases recorded are evidently pure idiosyncrasies, due not in the least to the peculiarity of the fruit, but to the peculiarity of the sufferer. The precise nature of these idiosyncrasies is very obscure, but they are certainly not due to mental influences, and the interesting circumstance that in the first case the rash always commenced *behind the ears* is evidence that irritation was caused to the ends of the pneumogastric nerve, which is connected with the skin only by a twig supplying the tissue at the back of the ear. A similar case has been reported to me on excellent authority, and is corroborated fully by the sufferer himself, of a rash being invariably developed in a boy after eating oatmeal, but in this instance it was unaccompanied by any alarming symptoms. A somewhat different case of idiosyncrasy is recorded in *The Lancet* (February 28, 1888, p. 394), in which a negro woman in Barbadoes experienced the most alarming symptoms after an ordinary dose of cocaine. THEO. D. A. COCKRELL.

West Cliff, Colorado.

Botanical expedition to S. America.

As various inquiries are made in regard to the botanical expedition to South America which I am contemplating, I feel at liberty to say a word in this public way about the matter.

The plan is to start at Buenos Ayres, in the Argentine Republic, ascend the Paraguay and Parana rivers as far as possible, and to collect the water and land plants in the surrounding region along the southern boundary of Bolivia and southwestern boundary of Brazil.

Attempts will be made to explore the tributaries of the great water system which empties through the Rio de la Plata into the Atlantic. Subsequently the Argentine Republic will be crossed westerly to the Andes, and a visit made to Chili, with attempts to collect the little known flora of the desert of Atacama.

Of course, these plans are liable to be modified by circumstances, but it is hoped that a large and rare collection of the South American flora of the regions visited may be made and brought home to enrich the herbaria of our country.

If further information as to the disposal of the sets collected is desired, letters may be addressed to the writer up to the 1st of June next, or to Dr. N. L. Britton, of Columbia College, New York.

Ashland, Mass. THOMAS MORONG.

Report of the U. S. Mycologist for 1887.

Into the portion of this report which concerns California several errors have crept that are to be regretted. All the fungi mentioned as having been observed for the first time in California exist in my herbarium, from numerous localities. Uromyces Betæ and Puccinia pruni-spinosæ were collected by me in 1876, and are included in *Cat. of Cal. Fungi*, published as long ago as 1880 Peronosporia viticola, an account of which, with some localities, was given in *Bull. Cal. Acad*, No. 7, June, 1887, abounds in California on our wild vine, Vitis Californica, and the denial of its existence by the U. S. mycologist will be productive of very mischievous results if it prevents our vine-growers from taking measures to protect themselves from this dreaded pest already in our midst.

San Francisco. H. W. HARKNESS

To the members of the Botanical Club of the A A. A. S.

Your committee, appointed in August last, to devise a method for the exchange of specimens among American botanists, have, after consultations with other botanists, decided that the most practical method is through the herbarium of the Department of Agriculture at Washington.

A classified stock of duplicates belonging to the department is available as a basis of an exchange herbarium.

Those desiring to exchange specimens should address, for rules and other information, Dr. Geo. Vasey, U. S. Dep. of Agriculture, Washington, D. C.

GEO. VASEY, SERENO WATSON, N. L. BRITTON, THOS. MORONG, B. D HALSTED, *Committee.*

CURRENT LITERATURE.

The families of plants.

The rapid advance in our knowledge of plants which has come from the wonderful development in appliances seems to demand a new general presentation of the plant kingdom. For the Phanerogams this is being undertaken in a masterly way by Drs. Engler and Prantl,[1] under whose editorship the best specialists are at work upon various groups of plants. The illustrations are abundant and most excellent, while the text is all that could be desired. The publisher is to be commended, not only for the handsome typography, but also for the very low price, which puts this invaluable work within the reach of almost every botanist. It appears in separate numbers, which come rapidly enough, but which hold no special relation to each other. Thus far the only completed parts are the second, fourth and fifth of the second volume, although several other numbers belonging to incompleted parts have appeared. A full discussion of the literature and anatomy of each family precedes the presentation of their classification, which includes the genera. Volume II, Part 2 (in 3 numbers), contains the *Gramineæ* by E. Hackel and the *Cyperaceæ* by F. Pax. Of the grasses 12 tribes are recognized, and 315 genera. In Cyperaceæ there are 65 genera, Carex being said to contain more than 500 species. Volume II, Part 4 (in 2 numbers), is more varied in its nature, containing several small groups, as follows: *Flagellariaceæ* (3 genera), *Mayacaceæ* (1 genus), *Xyridaceæ* (2 genera), *Rapateaceæ* (6 genera), and *Philydraceæ*. (3 genera), by A Engler; *Restionaceæ* (19 genera), *Centrolepidaceæ* (6 genera) and *Eriocaulaceæ* (6 genera), by G. Hieronymus; *Bromeliaceæ* (40 genera), by L. Wittmack; *Commelinaceæ* (25 genera), and *Pontederiaceæ* (6 genera), by S. Schönland. Volume II, Part 5 (in 4 numbers), contains *Juncaceæ* (7 genera), by F. Buchenau: *Stemonaceæ* (3 genera, among which is our Croomia), *Liliaceæ* (198 genera), by A. Engler; *Hæmodoraceæ* (9 genera), *Amaryllidaceæ* (71 genera), *Velloziaceæ* (2 genera), *Taccaceæ* (2 genera), *Dioscoreaceæ* (9 genera), and *Iridaceæ* (61 genera), by F. Pax. The Smilaceæ are included under Liliaceæ, while *Androstephium* Torr. is referred to the Mexican *Bessera* Schult., *Hesperanthes* Baker to *Anthericum* L., *Hastingsia* Watson to *Schœnolirion* Torr.. *Oakesia* Watson to *Uvularia* L., and *Prosartes* Don. to *Disporum* Salisb.

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[1] ENGLER, A., and PRANTL, K.—Die natürlichen Pflanzenfamilien nebst ihren Gattungen und wichtigeren Arten insbesondere den Nutzpflanzen. Volume II, Parts 2, 4 and 5. 8vo. Copiously illustrated. Leipzig: Wilhelm Engelmann, 1887. Subscription price M 1.50.

Adaptations to pollination.[2]

New methods of pollination are by no means readily discovered today, especially in so well-explored a field as Europe; but many details remain to be worked out, even in some of the best understood species, and the varying adaptations of the same species in separate localities, and the different behavior of their visitors under different conditions, still offer profitable occupation for good observers. The paper before us deals with some of these minor questions, relating to 176 species of the Giant Mountains of Germany.

Perhaps the most generally interesting part of the work is that relating to the Umbelliferæ, represented by 36 species. In volume vii of the GAZETTE attention was called to the seeming protogyny of *Erigenia*, *Sanicula*, and one or two other genera of this group, although some hesitancy was felt about accepting this as fully demonstrated. In a number of species studied by Schulz the styles are well developed when the flowers open, but the stigmas are said to be really unreceptive in the early stages of blooming in all of these apparent cases of protogyny. Yet, while truly protogynous Umbelliferæ appear to be still unknown (with the doubtful exception of *Erigenia*), the number of synacmic species is considerably increased. One is also struck by the large proportion in this list of Umbellifers with staminate flowers in addition to those that are hermaphrodite. The rudimentary umbellet of red flowers in the common carrot (present in only about one-sixth of the individuals examined) has proved quite as serious a puzzle to this observer as to others, whose explanations, however, are not satisfactory to him.

Much of the remainder of the paper is taken up with useful notes on the different forms of flowers in species of Caryophyllaceæ and Labiatæ, but nothing essentially new in principle is added. The part actually played by insects in pollination is brought in for very little comment, though some care has evidently been given to this class of observations.—W. T.

De Bary on bacteria.

The literature of bacteria is increasing with astonishing rapidity, both in the form of magazine articles and pamphlets and of bound volumes. Among all this array of facts and opinions, put together with multiplicity of details and bewildering uncertainty as to the relative credence to be accorded the various authors, the task of forming a well balanced and serviceable conception of the present state of the science of bacteriology is well-nigh insurmountable for all but a few specialists. To have one in whom the utmost confidence can be placed go over all the ground, and carefully state the main facts with their true perspective—in short, to bring out a satisfactory orientation of the subject, using simple and attractive language, is a much needed service. It is no less than this that De Bary, whose recent death has been so great a loss to the scientific world, has done in the publication of his lectures under the title, *Vorlesungen über Bacterien.* This work, issued in 1885, met with an extended sale, calling for a second edition the following year. Another year saw it in English dress,[3] being translated by Mr. Garnsey, and revised by Prof. Balfour, who have been associated in giving us excellent English versions of several other standard German works.

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[2] SCHULZ, AUG.—Beiträge zur Kenntniss der Bestäubungseinrichtungen und der Geschlechtsvertheilung bei den Pflanzen. (Bibliotheca Botanica, Heft 10.) 104 pp. 1 pl. Cassel: Theodor Fischer, 1888.—M. 8.

An extended notice of the first German edition was given in this journal for May, 1886, which makes it unnecessary to occupy much space at this time. The work is remarkably clear in expression, concise and masterful in the selection and arrangement of subject matter, and has been put into an attractive and handy form by the publishers. It is specially noteworthy that the English volume in form and size is more satisfactory than, and in other respects quite equal to, the German, which is good fortune that rarely accompanies the translation of botanical works.

Instead of enumerating the various topics treated, it will suffice to say that the work gives a view of the whole field of the science, with particular, although brief. treatment of many of the more prominent and debatable questions, and a special examination of the relation of bacteria to fermentations and other chemical changes, and to the production of disease in plants and animals. A valuable bibliography and an index complete the volume.

Minor Notices.

THE "CENTRAL EXPERIMENTAL FARM" of the Department of Agriculture of Canada devotes its third bulletin[4] to the smuts attacking wheat and remedies for the same. Tilletia caries, T. lævis and Ustilago carbo are described and figured. Copper sulphate solution, strong brine and a weak alkali are recommended as preventives when applied to the seed wheat before sowing

MISS NEWELL has prepared a very useful series of outlines of lessons in botany,[5] which is now being issued in parts. The lessons outlined are intended for children 12 years old and upward. They follow the order of Dr. Gray's "Lessons" and "How Plants Grow," and are designed to be used in connection with these books. No doubt they will prove very suggestive to teachers of the little folks. Certainly, the subjects they treat are much more suitable pabulum for youngsters than the histology proposed by Mrs. Knight in her "Primer of Botany."

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[3] DE BARY, A.—Lectures on bacteria; second improved edition. Translated by Henry E. F. Garnsey, M. A.; revised by Isaac Bayley Balfour, M. A., M. D., F. R. S. 193 pp., 20 wood engravings, 12mo. Oxford: Clarendon Press, 1887. [Macmillan & Co., New York.]

[4] FLETCHER, JAMES—Smuts affecting wheat (Bull. III, Cent. Exp. Farm), pp. 15, fig. 7. 8 . Ottawa, Dep't of Agriculture, Mch. 15, 1888.

[5] NEWELL, JANE H.—Outlines of Lessons in Botany, for the use of teachers or mothers studying with their children. Parts 1—4. Square 12mo. [Cambridge, Mass.: the author.] Printed at the Salem Press, Salem, Mass.

Dr. Gray's last Contribution[6] is before us, being a continuation of one in the last volume of the *Proc. Am. Acad.* It contains his notes upon the Rutaceæ, and only the beginning of Vitaceæ. Cneoridium is restored to Rutaceæ on account of its glands. Xanthoxylum is shown to be proper, and not Zanthoxylum. Amyris (formerly in Burseraceæ) is transferred to Rutaceæ, and a new species from Texas described. The only thing touched upon under Vitaceæ is Ampelopsis, which Dr. Gray retains as a genus, with A. quinquefolia as the type, thus not accepting Planchon's Parthenocissus, nor his definition of Ampelopsis.

NOTES AND NEWS.

Prof. Thos. C. Porter sails for Europe May 26.

Dr. J. Pancic, of the Botanic Gardens of Belgrade, died March 8, at the age of seventy four years.

Prof. B. D. Halsted has an interesting paper in the *Popular Science Monthly* (April) upon "California dry-winter flowers."

Dr. Prantl, called to the Eberswald school of forestry to succeed Dr. Luerssen, has declined, and will remain at Aschaffenburg.

The announcement of the Shaw School of Botany for 1887–8 shows an attendance of 43 special students during 1887—26 in the spring and 17 in the fall.

New species of North American Phanerogams are described by Dr. N. L. Britton in *Bull. Torr. Club* (April), chiefly Cyperaceæ, together with critical notes upon certain noteworthy species.

The forestry division of the Department of Agriculture has issued a short circular on methods of increasing the durability of timber whose admonitions would be of value to wood consumers—if they would heed them.

Prof. E. L. Greene, continuing his bibliographical notes in *Bull. Torr. Club* (April), replaces *Gleditschia monosperma* Walt. by the prior *G. inermis* Mill; and the western *Hesperochiron Californicus* Watson by *H. nanus* Lindl.

The rumor that Dr. Graf zu Solms-Laubach was to succeed Dr. De Bary at Strasburg is confirmed. He has declined the call to Berlin, and will enter upon his work at Strasburg at the beginning of the summer semester.

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[6] Gray, Asa.—Notes upon some polypetalous genera and orders. Proc. Am. Acad. XXIII, pp. 223-227. Issued April 19, 1888.

A. A. CROZIER, assistant botanist to the U. S. Department of Agriculture. has been appointed botanist to the state experiment station at Ames, Iowa, and has already entered upon his duties.

THE REPORT of the botanical section of the Philadelphia Academy of Sciences for 1887 shows that the collection contains 27,267 species of phanerogams and ferns, over 1,000 of which were added during 1887.

DR. J. C. ARTHUR sails from New York May 16, and intends visiting the principal universities and experiment stations in England, Holland and Germany, returning in time for the A. A. A. S. meeting in Cleveland.

DR. H. FREIHERR VON BRETFELD, professor of botany at the Polytechnikum of Riga, died in February, at the age of thirty-five years. He published an excellent work on the physiology of plants in relation to agriculture in 1884.

THE KEW BULLETIN for March contains seven numbers, as follows: Forsteronia rubber, Patchouli, W. African indigo plants, Vanilla (with plate, illustrating its fertilization), Streblus paper, Urera fibre (with plate of U. tenax), and Tea.

PROF. B. D. HALSTED is writing a series of five articles for the *Chautauquan*, under the following titles: (1) Seeds, and how they travel; (2) The unfolding of plant life; (3) Plants at work; (4) Flowers and fruits; (5) Flowerless plants.

AN INTERESTING article on the position of the roots of plants under field culture and their relation to moisture and cultivation is given by E. S. Goff in the last number of the Proceedings of the Western New York Horticultural Society.

A LIST of fungi which occur upon different cultivated fruits has been published by Baron von Thümen, under the title *Pilze der Obstgewächse*. The species found on the several parts of the plant are grouped alphabetically. There are over 4,200 kinds enumerated on 77 different hosts.

A LAW to make the destruction of barberry bushes obligatory in France, Spain, Italy and Switzerland, except for ornamental purposes in gardens and parks, on account of the æcidium promoting the increase of wheat rust, is being urged by the French National Society of Agriculture.

THE MEMORIAL pamphlet published by the University Press at Cambridge in honor of Dr. Gray contains the funeral sermon by Rev. A. McKenzie, order of funeral services, selections from the Bible read by Rev. Dr. Peabody, remarks by Dr. McKenzie, and an address by Dr. Peabody.

A LIST of 170 species of plants collected by Miss Mary B. Croft, in 1884-85, in western Texas, named by Drs. Britton and Rusby, is published in Transactions of the New York Academy of Sciences for 1887 (VII, p. 7), containing the description of one new species. This is a white-flowered Houstonia, H. Croftiæ, growing but an inch high. Some minor changes of nomenclature occur in the list.

ONE OF THE most thoroughly satisfactory illustrations of fungi we have ever seen is a photo-print of Boletus luteus tinted by hand in water-colors, illustrating an article on the use of photography for the larger fungi, by M. Bourquelot in the *Bulletin Soc. Mycologique de France* (III, p. 185) for 1887. The character of the pores on the under surface is brought out with marvelous softness and fidelity.

PROF. L. H. BAILEY, JR., of the Agricultural College of Michigan, has accepted the chair of horticulture in Cornell University, and of horticulturist to the agricultural experiment station, at a salary of $3,000 a year, with a year's leave of absence to visit Europe at such time as he may select, without interruption of salary. He remains in Michigan until August.

A REVISION of the genus Doassansia, by Dr. J. B. DeToni, of Padua, Italy, is given in the current number of the *Journal of Mycology*, page 13. Eleven species are admitted, characterized in Latin, with full synonymy and additional notes. These species are exclusively American, while two others also occur in the United States. The bibliography contains titles of twenty-six articles and nine exsiccati.

THE POSITION and value of botany in agricultural experiment stations is broadly and suggestively treated by Dr. B. D. Halsted in *Agricultural Science* for March. The physiological, structural, systematic and pathological aspects of the subject are duly considered, and stress is laid upon the necessity of familiarizing the public with the fundamental facts of the science by means of carefully written bulletins.

THE *Journal de Botanique*, under the direction of M. Louis Morot, continues its second year with increased interest. A catalogue of Parisian plants, by Cornuti, is running through the numbers, while the following titles show the general nature of the papers: The Mutisiaceæ of Yun-Nan (with plates of new genera and species), by Franchet; The periderm of Leguminosæ, by Douliot; Nuclear and cell-division, by Strasburger; Herborisations about Montpellier, by Flahault; The fruit of Solaneæ, by Garcin.

THE PATHOLOGY of pollen in hay-fever is discussed by Prof. Samuel Lockwood in *Jour. N. Y. Micr. Soc.* (April). A plate shows the pollen of Ambrosia and Solidago, and four possible modes of action for pollen in hay-fever are given, as follows: (1) Its suffocating effect as an impurity of the atmosphere, thus exciting asthma; (2) as a mechanical irritant, begetting inflamation, even to excoriation of the mucous membrane; (3) as a toxic agent, poisoning the tissues; (4) as a pseudo-parasite, penetrating the soft and sensitive parts.

THE RESISTANCE of pollen to external influences was the subject of a recent inaugural address by Herr Rittinghaus at Bonn (*Naturf.* 1, 1888). In the matter of temperature, 104.5° C. for 10 minutes was found to be the maximum for germination. A moderate temperature (32° C.) is favorable to the development of pollen tubes, while low temperature (under 9° C.) prevents germination. Vapor of chloroform for 20 min. was fatal, bromine vapor in 5 min., and ammonia in 10 to 20 min. The retention of the power of germination differs widely in plants, but the average is 30 to 40 days.

AT A RECENT MEETING (Feb. 16) of the Linnæan Society Mr. H. N. Ridley read a paper on self-fertilization and cleistogamy in orchids. The common methods of self-fertilization were described as follows: (1) By the breaking up of the pollen mass, and falling of the dust either directly upon the stigma, or into the lips, whence it comes into contact with the stigma; (2) by the falling of the pollen masses as a whole from the clinandrum into the stigma; and (3) by the falling forward of the pollinia from the clinandrum, or the anther cap, the caudicle and gland remaining attached to the column.—*Nature* (March 8).

BOTANY is strongly represented in the organization of the Tennessee experiment station. Prof. F. Lamson Scribner, at present chief of the section of vegetable pathology of the U. S. Department of Agriculture, is placed in charge of botany and horticulture, and also made professor in the university; W. E. Stone, now studying at the University of Göttingen, and well known to our readers as a contributor of articles on physiological botany is made chemist; and Prof. C. S. Plumb, of the university, and editor of *Agricultural Science*, who has made practical studies of cultivated plants and their diseases, is assistant director.

ILLUSTRATIONS of the dispersion of seeds and plants by way of the alimentary canal of various animals are given in *Nature* (March 15) by Mr. D. Morris. Pithecolobium Saman, a large and important leguminous tree, was introduced into Jamaica from Venezuela by means of cattle. The legumes were fed to the cattle during the voyage, and the seeds were voided free from the pod, and so much softened as to rapidly germinate. The tree was thus introduced by the very animals that required it most for shelter, shade and food. In India the Acacia arabica, or babul, is regularly induced to speedy germination by feeding babul leaves and pods to flocks of goats. In St. Helena they dare not use "urban" manure because the land would become overrun by prickly pear (Opuntia Ficus-Indica), the fruit of which is largely consumed by the inhabitants.

SKETCHES of the life and labors of Dr. Asa Gray are numerous, but no one that has reached us is more appreciative and judicious than that by Dr. J. D. Hooker, in *Nature* (Feb. 16). The opening paragraph gives us the place of our botanist in a new and very suggestive way: "When the history of the progress of botany during the 19th century shall be written, two names will hold high position, those of Prof. Augustin Pyrame DeCandolle and Prof. Asa Gray. In many respects the careers of these men were very similar, though they were neither fellow countrymen nor contemporaries, for the one sank to his rest in the Old World as the other rose to eminence in the New. They were great teachers in great schools, prolific writers, and authors of the best elementary works on botany of their day. Each devoted half a century of unremitting labor to the investigation and description of the plants of continental areas, and they founded herbaria and libraries, each in his own country, which have become permanent and quasi national institutions. Nor were they unlike in personal qualities, for they were social and genial men, as active in aiding others as they were indefatigable in their own researches; and both were admirable correspondents. Lastly, there is much in their lives and works that recalls the career of Linnæus, of whom they were worthy disciples, in the comprehensiveness of their labor, the excellence of their methods, their judicious conception of the limits of genera and species, the terseness and accuracy of their descriptions, and the clearness of their scientific language."

DR. A. F. W. SCHIMPER has published an exceedingly interesting and valuable paper[1] upon the formation of calcium oxalate in foliage leaves and the *rôle* of calcium salts in the plant economy. The subject has long attracted investigators, and the literature is, therefore, quite extensive. Schimper finds calcium oxalate crystals in small quantities formed in leaves during their growing period, which he calls *primary*, and whose formation is not taken into account. The *secondary* calcium oxalate, however, occurs widely distributed in plants and in very considerable quantities. It is formed after the leaves have ceased growing, and its formation is directly dependent upon light, the presence of chlorophyll and transpiration, but is *not* related to the assimilation of carbon. It is shown that calcium oxalate can pass from one cell to another. This fact, together with those just cited, renders it probable that it is formed in the green cells and then passes to others more or less empty, where it crystallizes. He further shows that nitrate, sulphate and phosphate of calcium exist in leaves quite generally, particularly in the parenchyma of the veins and that neighborhood, where these substances seem to be stored. These salts are split up *by the green cells under the influence of light* and the nitrogen, sulphur and phosphorus used in the manufacture of proteids, while the calcium combines with oxalic and perhaps carbonic and other acids. The resulting salt is to be looked upon in this case as a by-product of nitrogen-assimilation, etc. But the calcium salts are shown to have another and quite important *rôle*, namely, to promote the translocation of the starch produced by carbon assimilation. Plants grown in calcium-free solutions accumulated starch in the green cells while the tissues in which it is ordinarily conducted away remain quite free from it. Moreover, under these conditions the epidermis of the plants used, which contained large leucoplasts, had very little starch gathered about them, while the green cells below and even the guard-cells were gorged with it. It would seem indisputable that the presence of calcium was indispensable for the transfer of starch. Schimper does not deny that the formation of proteids from inorganic materials may take place in other parts of the plant, as in meristem. Nor does he consider that the formation of proteid by fungi militates against his conclusions. The nitrogen assimilation of fungi, he says, appears to depend upon entirely different chemical process from those in green plants.

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[1] Bot. Zeit., nos. 5 to 10, 1888: Ueber Kalkoxalatbildung in den Laub-blattern.

Carl Dünnenberger has published[2] an account of his critical researches upon the lightening of bread dough. The paper is a long and able one. His most important result is the showing that "the normal fermentation of bread is alcoholic, whether one uses yeast or leaven[3] to render it porous." The only essential ferment-organism is the yeast. Maltose, the substance fermented, is produced from a part of the starch of the flour by the action of a diastatic enzyme, *cerealin*. Bacteria are, as far as normal bread-fermentation is concerned, an impurity, and are absolutely unnecessary. The raising of bread dough depends, in the first place, upon the carbonic acid set free by the alcoholic fermentation. Afterward there is, in consequence of the temperature of the oven, an expansion of or volatilization of various substances which assist the raising action, namely, air, alcohol, water and (in an accessory, subordinate way) the volatile fatty acids formed by bacteria." Wigand's Bacterium farinaceum and Laurent's Bacillus panificans are thus thrown overboard, as far as their physiological action is concerned, and our light breads, whether by "salt-rising" or "Fleischmann's," depend on some budding saccharomycete.

Dr. William Trelease will sail for Europe early in June.

Dr. George L. Goodale has been appointed "Fisher Professor of Natural History" by the corporation of Harvard University.

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[2] Bot. Centralblatt, no. 8, 1888, p. 245 et nn. seq.: Bacteriologisch-chemische Untersuchungen über die beim Aufgehen des brotteiges wirkenden Ursachen.

[3] *I. e.*, dough left from one baking to another, either with or without the addition of an extract of hops or malt.

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Some notes on Western Umbelliferæ. II.

JOHN M. COULTER AND J. N. ROSE.

Eryngium petiolatum Hook. has been made to contain all our Pacific forms, until that species has become a collocation of most dissimilar plants. In our study of this group, the nebulous mass called E. petiolatum has been resolved into at least four distinct forms. We have characterized E. petiolatum as follows: Erect, 1 to 5 feet high, branching above (or from the base in low forms): radical leaves oblanceolate, spinosely and unequally serrate, attenuate into an elongated fistulous petiole (submerged leaves consisting only of the terete jointed petiole); stem-leaves mostly sessile: involucral bracts linear-lanceolate, spinosely-tipped and toothed (sometimes an inch long), longer than the peduncled globose head; bractlets lanceolate, cuspidate-tipped, scarious-margined below, but little longer than the flowers: calyx-lobes resembling the bractlets, but smaller, much shorter than the long styles.—Mostly in marshes, throughout California (*Greene*, *Lemmon* 108, *G. R. Vasey* 223 and distributed as var. *armatum*, *Cleveland*, etc.). We have seen no Oregon representative of this species. It varies greatly in size, and in drier places passes into a dwarfed form but 1 to 3 inches high, with all the parts correspondingly reduced (Donner Lake, *C. F. Sonne*).

We would disentangle the following three species from E. petiolatum, giving chiefly the points of difference:

Eryngium armatum, n. sp. Diffuse, branching throughout, a foot or so high: serrate to spinose-dentate or incised radical leaves attenuate into a short more or less margined petiole: involucral bracts and bractlets lanceolate (broadest at base), entire (rarely toothed at base), rigid, thick margined, much longer than the head: calyx-lobes acuminate-lanceolate, longer than the short styles.—*E. petiolatum*, var. *armatum* Watson, Bot. Calif. 1. 255.—California, from San Diego to Humboldt and Butte counties. Its range has been extended southward from that given in the Botany of California by *Palmer* 155 (San Luis Obispo) and *Orcutt* (San Diego), as well as to Butte county by *Mrs. R. M. Austin*. In the collections of Pringle, Orcutt, and Mrs. Austin, it was distributed as *E.*

petiolatum, from which it differs in its low, diffuse branching habit, short petioled radical leaves, broad entire rigid bracts and bractlets, all similar and conspicuously longer than the head, and short styles.

Eryngium Vaseyi, n. sp. Stems a foot or less high (sometimes reduced to 2 or 3 inches), several from a common root and branching above: leaves unequally spinulose-serrate, attenuate below: involucral bracts and bractlets narrow, thick and rigid, spinose and spiny-toothed, much longer than the head: calyx-lobes lanceolate, acuminate-cuspidate, longer than the short styles.—In wet ground, California, San Antonio river, July, 1880 *(G. R. Vasey* 222, distributed as *E. petiolatum)*, and Chico *(Mrs. R. M. Austin)*; S. W. Oregon, near Medford *(Howell*, a much reduced form).—This species is remarkable for its narrow, very spiny bracts and bractlets, much more rigid than in *E. armatum* and spiny-toothed. The calyx-lobes also have stronger cuspidate tips than in that species.

Eryngium articulatum Hook. Erect, 1 or 2 feet high, more or less branching throughout: radical and lower stem-leaves reduced to very long (sometimes a foot long) jointed petioles, with or without a small lanceolate blade (from entire to laciniately toothed): involucral bracts linear, cuspidate-tipped and spiny-toothed (about half-inch long), longer than the head; bractlets tri-cuspidate, the middle one much the largest, scarcely longer than the flowers: calyx-lobes lanceolate, cuspidate-acuminate, hardly longer than the styles.—*E. petiolatum*, var. *juncifolium* Gray, Proc. Am. Acad. viii. 385.—Swamps and wet meadows, Washington Territory, Falcon Valley *(Suksdorf)*; Oregon *(Nuttall*, *Hall* 200, *Howell*, *Henderson)*; California, Plumas county *(Mrs. R. M. Austin)*. Numerous very immature specimens of this species are to be found in herbaria in which the bracts seem very prominent; but it is simply owing to the immaturity of the heads. This is the western representative of the eastern E. Virginianum group.[1]

Peucedanum Martindalei, n. sp. Resembling *P. Hallii* in

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[1] The following species, a member of this group, turns up among Florida collections labeled *E. præaltum* Gray:

E. Floridanum, n. sp. Erect, 2 or 3 feet high, somewhat branching above: lower leaves narrowly oblong (1 to 4 inches long), mostly entire, on long fistulous jointed petioles (sometimes a foot long): upper ones becoming sessile, elongated-linear, usually remotely serrulate: involucre of linear-lanceolate, rigid, sharp-pointed, entire or spiny-toothed, reflexed bracts longer than the subglobose heads; bractlets linear, rigid, entire, tapering to a pungent tip, much longer than the flowers: fruit scaly, with short ovate acute calyx-lobes, and very long rigid styles.—Brackish marshes, Florida, Tampa (*Garber*), and near Jacksonville (*Curtiss*). Distributed as *E. præaltum* Gray, but differing from all species of that group in its entire bractlets.

habit and foliage, but differing in leaves, sometimes bipinnate with toothed or pinnatifid segments; fruit 4 to 7 lines long, 3½ lines broad, with wings much broader than body (which is but a line), and prominent dorsal and intermediate ribs; oil-ducts solitary in the intervals, 2 on the commissural side; and seed-face somewhat concave, with central longitudinal ridge.—Rocky places, Cascade Mountains, Oregon (*Howell*, 1880), flowering in May. Distributed as *P. Hallii*, but differs decidedly in its fruit characters. Dedicated to Mr. I. C. Martindale, to whose collection of Umbelliferæ we are very much indebted.

Var. **angustatum.** Usually more caulescent and taller, with more dissected leaves, and wings of fruit but half a line wide, making a fruit 2 lines wide.—Oregon, Cascade Mountains (*Howell*), Mt. Paddo (*Suksdorf*); Washington Territory (*Brandegee* 323, *Tweedy* 281); also Vancouver Island, Mount Arrowsmith, alt. 5,500 feet (*Macoun* 19). Also distributed as *P. Hallii.*

Peucedanum Donnellii, n. sp. Shortly caulescent or acaulescent, 6 to 12 inches high, glabrous, from a fusiform root: leaves ternate and then pinnately decompound, with segments pinnately cleft into short oblong or linear lobes: umbel somewhat unequally 6 to 12-rayed, with mostly no involucre, and involucels of linear acuminate bractlets; rays 1 to 4 inches long; pedicels 2 to 8 lines long; flowers yellow: fruit ovate to broadly oblong, glabrous, 3½ to 4 lines long, 2 to 3 lines broad, with wings less than half as broad as body, and prominent dorsal and intermediate ribs: oil-ducts small, 4 to 6 in the intervals, 4 to 6 on the commissural side.—Oregon (*Cusick* 36, in 1883), John Day Valley (*Howell* 829, in 1885). Flowers in April. Most nearly related to *P. Nevadense* Wats. Dedicated to John Donnell Smith, in whose collection the species was first detected.

Peucedanum Californicum, n. sp. Short caulescent, glabrous, with a solitary peduncle rising from 4 inches to a foot high: leaves clustered near the base, large (4 to 6 inches long), bipinnate (the upper leaflets confluent); leaflets broad, obtuse (usually ending truncately or emarginately between two divaricate teeth), irregularly incised and with broad strongly cuspidate teeth: umbel 8 to 10-rayed, with no involucre, and involucels of distinct lanceolate acuminate bractlets: rays 1 to 1½ inches long; pedicels about 3 lines long; flowers yellow: fruit (immature) ovate, glabrous: oil-ducts solitary in the intervals, 2 on the commissural side.—San Luis Obispo, California, May 5, 1882 (*Marcus E. Jones*). Distributed as *P. parvifolium* T. & G. This is a very distinct species of the *Euryptera* section.

Peucedanum Vaseyi, n. sp. Shortly caulescent, 6 to 8 inches high, pubescent: petioles wholly inflated; leaves small (1 to 2 inches long), bipinnate, with the small ovate segments irregularly 3 to 5-lobed: umbel equally 2 to 5-rayed, with no involucre, and involucels of obovate petiolulate toothed bractlets; rays an inch long; pedicels a line or two long: flowers yellow: fruit broadly oblong, emarginate, glabrous, 6 or 7 lines long, 4 lines broad, with wings twice as broad as body, and prominent dorsal and intermediate ribs: oil-tubes solitary in the intervals, 4 on the commissural side.—San Bernardino Mountains, California, May, 1880 (*G. R. Vasey* 231); mesas, San Bernardino, April, 1881 (*S. B. & W. F. Parish* 286 in part). Distributed by Vasey as *P. macrocarpum* Nutt., var.; and by Parish as *Cymopterus terebinthinus* T. & G.

Selinum Grayi, n. sp. Stout (sometimes very much so), 1 or 2 feet high, glabrous except the more or less scabrous inflorescence, leaf-margins, and veinlets (beneath): leaves once to twice pinnate, with much dilated petioles; leaflets oblong to ovate, about an inch long, acute, toothed (sometimes lacinately-toothed or lobed): umbels with involucels of conspicuous lanceolate-ovate long-acuminate bractlets; rays 1 to two inches long; pedicels 1 to 2 lines long: fruit oblong, glabrous, 2 to 2½ lines long, with prominent thin wings, the lateral ones decidedly broadest: oil-ducts conspicuous: seed dorsally sulcate.—High mountains of Colorado (*Vasey* in 1868, *Canby* in 1871, *Coulter* in 1873, *Trelease* in 1886); also probably *Hall & Harbour* 219 and *Parry* 154. Distributed as Archangelica Gmelini, and so called in the Flora Colorado and Coulter's Rocky Mountain Manual. So far as we have seen all the Archangelica Gmelini reported from Colorado is this species. Its general habit resembles that of an Angelica somewhat, but its fruit characters are very different, and entirely those of Selinum.

Selinum Dawsoni, n. sp. A foot or so high, glabrous: leaves ternate then bipinnate, the small (¼ to ½ inch long) ovate acute segments laciniately toothed to entire: umbels with involucels of linear-oblong scarious bractlets longer than the pedicels and abruptly ending in a long attenuation; pedicels 1 to 2 lines long: fruit oblong, smooth, about 2 lines long, with prominent thin wings, the lateral ones but little broader: oil-ducts conspicuous, rarely an additional small one in a lateral interval: seed hardly at all dorsally sulcate.—Pelly River, at Pelly Banks, Yukon, lat. 61°, August 11, 1887 (*Dawson* 23). This interesting species is quite distinct from all our Selinums in its leaf and involucral characters, as well as in the prominent thin wings of the fruit.

Cœlopleurum Gmelini Ledeb. The range of this species has been confused by referring to it *Selinum Grayi* C. & R. of the Colorado Rocky Mountains. Occurring on the Atlantic coast from Massachusetts Bay to Labrador, we have seen no specimens from the Pacific coast south of Vancouver Island (*Macoun*). It extends from that island to Alaska, and very likely will be found on the coast of Washington Territory and Oregon. We have not discovered that this species is found at all in the interior. In Washington Territory, however, the following coast species has been discovered:

Cœlopleurum maritimum, n. sp. Stem 2 to 3 feet high: leaves 2 to 3-ternate; leaflets broad, often round, usually with cordate base, very obtuse, dentate or crenate-dentate, 2½ to 3 inches long, 2½ inches broad: umbel many-rayed, with involucels of linear-lanceolate bractlets; rays 2 to 3 inches long; pedicels 6 to 7 lines long: fruit oblong, 3 to 3½ lines long, with lateral ribs broadest and seed-face concave.—Wet ocean bluffs, Long Beach, Ilwaco, Washington Territory, July 24, 1886 (*L. F. Henderson* 384).

Ligusticum apiifolium Benth. & Hook. This species is found chiefly in the mountains of Oregon, and extends into California. It is very evident, from a study of herbarium specimens, that it has been much misunderstood; for, while we discover any number of sheets labeled *L. apiifolium*, very few of them prove to be that species. The Oregon plant is represented in the older collections by *Hall* 207, and recently by *Howell* 6 and *Henderson* 1589. The Californian stations are Yosemite valley (*Bolander*), Big Tree road and Ebbett's Pass (*Brewer*), and Donner Lake (*Torrey*). The small oval fruits, smaller than in any other species, with their narrow ribs and reniform seed-section, easily separate it from other Ligusticums. Its range, apparently limited to the mountains of Oregon and N. California, serves well to separate it from the Colorado L. scopulorum, with which it seems to have been confused.

Ligusticum scopulorum Gray. So far as we can discover, this species does not occur beyond the Rocky Mountains, and chiefly in Colorado. It extends also into N. Arizona (*Palmer* 176, *Rusby* 630). Certain Colorado forms, with immature fruit, referred to this species, differ somewhat in foliage from typical L. scopulorum, and simulate Conioselinum Canadense so very closely that mature fruit is necessary to distinguish them. Collectors should carefully note whether any so-called specimens of L. scopulorum develop fruit with lateral wings. These wings are often developed so late in the maturing of the fruit that it must be fully ripe before any decision can be made.

Wabash College, Crawfordsville, Ind.

Zygomorphy and its causes. I.

CHARLES ROBERTSON.

Since reading a foot-note in Gray's Structural Botany[1] referring to the observation of Sprengel, that irregular flowers are adapted to insects, and "that strictly terminal and also vertical flowers, whether erect or suspended, are seldom irregular, while comparatively horizontal or obliquely set flowers more commonly are so," and also referring to the remark of Darwin,[2] "that he does not know of a single instance of an irregular flower which is wind-fertilized," I have often wondered what are the conditions in the insect relations of horizontal flowers which make advantageous such variations as are in the direction of irregularity. In the observation of the behavior of insects on such flowers I have found answers to some of the questions thus suggested.

Two papers on the causes of zygomorphy have recently appeared, one by Herman Vöchting[3] and the other by Frederick Delpino.[4] My observations approach the subject from a stand-point so different that it is hardly necessary to give more than references to these papers. However, it may be well, by way of introduction, to mention some of the points considered by Delpino; and I am more inclined to do this from the fact that he introduces a few terms which are convenient in characterizing irregular flowers.

Of the causes which are supposed to have operated in the production of floral irregularity Delpino recognizes three categories, viz., the instrumental and mechanical (cause stromentali e meccaniche), the influencing or conditional (cause influenti o condizionali), the final, functional, or biological (cause finali, funzionali, o biologiche).

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[1] 219, note 1.

[2] Forms of Flowers, 147.

[3] Ueber Zygomorphie und deren Ursachen. Jahrb. für wissench. Botanik. Bd. XVII, H. II, 1886, 297-346. See also Bot. Zeit. 1887, 436.

[4] Zigomorfia florale e sue cause, Malpighia, Anno I, Fasc. VI, 1886, 245-262.

Of zygomorphy four grades are distinguished. In the first grade (recentissima) the irregularity is limited to a deflection of the stamens and styles. The second (recente) and the third (inveterata) form transitions to the fourth (inveteratissima), in which there is unequal development of one or more circles with partial or total abortions of certain organs, as in the orchids. Flowers of the first two grades belong to groups in which the types are regular, those of the last two belong to zygomorphous groups.

From the point of view of final or functional causes zygomorphy is an adaptation for cross-fertilization by special insects and honey-sucking birds. Most irregular flowers are adapted to bees (melittofili). Many are adapted to hawkmoths (sfingofili) and birds (ornitofili), few to butterflies and flies. If the stamens and styles turn so as to strike the visitor on the back, the flower is *nototribe;* if they strike the under surface of the visitor, the flower is *sternotribe;* if pollen is applied to the side of the insect, the flower is *pleurotribe.*[5]

Nototribe flowers adapted to bees are most Labiatæ, Scrophulariaceæ, Bignoniaceæ, Lobeliaceæ, etc. Adapted to birds is Epiphyllum truncatum.[6] Sternotribe bee-flowers are most Papilionaceæ, Rhododendron, etc. Amaryllis formosissima is adapted to birds,[7] and Lilium longiflorum is sphingophilous. Pleurotribe flowers are adapted to bees, *e. g.*, Phaseolus, Lathyrus sylvestris and Polygala myrtifolia.[8]

Two proterandrous flowers, Teucrium Chamædrys and Ocymum Basilicum, are compared. The former is nototribe, the latter sternotribe. In the male stage in Teucrium the stamens turn down and the styles turn up; in Ocymum the stamens turn up and the style turns down. In the female stage in Teucrium the stamens turn up and the style turns down; in Ocymum the stamens turn down and the style turns up. These adaptive movements are referred to the operation of biological causes. Wind-fertilized flowers are actinomorphic, and belong to actinomorphic orders.

To the mechanical theory of De Candolle, that irregularity was caused by compression in the axils of leaves, *i. e.*, between the leaves and the axis, it is objected that some terminal flowers are irregular, and many axillary flowers are regular.

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[5] "Potendo darsi tre sorta d'impollinazioni, nototriba cioe, sternotriba e pleurotriba."

[6] Lobelia cardinalis and Salvia splendens are other examples. See Trelease Am. Nat. XIII. 427, and XV. 265.

[7] Tropœlum majus is commonly visited by the ruby-throated humming-bird.

[8] Perhaps better examples were described by J. E. Todd, Am. Nat. XVI. 281, Cassia Chamæcrista and Solanum rostratum.

The fifth stamen of didynamous flowers is partially or totally aborted, and is found in the plane of greatest pressure. But this stamen, if developed, would occupy the place of the style, and might defeat the contrivances for cross-fertilization, so that this abortion may also be referred to functional causes.[9] Admitting the association of the two sets of causes, which ought to be regarded as having more influence? Citing the case of Pentstemon and Jacaranda, in which the fifth stamen is even more strongly developed than the others, though not antheriferous, he says: "Behold, in this case the biological cause has triumphed over the mechanical."

In Ajuga and Teucrium the upper lip is reduced, which may be attributed to the action of mechanical causes, from being in the plane of greatest pressure, but in Salvia the upper lip is strongly developed. "Behold a new example of the prevalence of biological causes."

Since the pressure between the bracts and axis operates in a vertical direction the expansion ought to be in an horizontal direction; but the organs are most strongly developed in a vertical direction, in the plane of greatest pressure. Finally, the author concludes that, ninety times in a hundred, mechanical causes are subordinate to the functional.

To say that a flower is adapted to be cross-fertilized by certain insects seems to Delpino to be a sufficient explanation of it, but Mr. Darwin would say that it is only another way of saying that it is as we find it. If instead of "cause finali" we substitute natural selection, we shall have a known cause, and natural selection is a functional cause, since it operates only on variations which involve a functional advantage.

It is interesting, however, to observe that even teleological considerations may be sufficient objections to views which undertake to account for zygomorphy, while ignoring the selective influence of insects; for it is inconceivable that any cause, such as gravitation, should operate in such a regular way as to effect and maintain an adjustment to certain kinds of visitors. Suppose an insect lights on the stamens and styles of an horizontal flower, how can gravitation have more power to facilitate fertilization by turning these organs up at the tips than to prevent it by turning them down? If it bends the styles in different directions fertilization will be more likely to occur in those flowers whose styles turn up. In this way the selective influence of insects will determine that only those flowers will be preserved whose styles are affected in a certain way by gravitation, so that the influence of gravitation will be subservient to the selective influence of insects. If, however, the action of the clinostat destroys the curvature of the styles, this character is said by Vöchting to be due to gravitation. If it fails to destroy other characters these are referred to an internal cause.

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[9] This abortion is attributed to natural selection by Müller (Fertilization of Flowers, 434) and Lubbock (Brit. Wild Flowers in Relation to Insects, 136).

It seems to me that the principle of selection is the strength of the philosophy which undertakes to account for the origin of adaptations. There can be no doubt that different causes suggested by authors have operated to produce modifications in lateral flowers, but, as already observed, it is inconceivable that any of these causes should have had any influence in the absence of insects. On the other hand, insects can not be supposed to have produced variations, but, by determining that variations of a certain kind are advantageous, they are the cause of those modifications becoming permanent characters of the flowers, so that, after all, they may be considered to be the cause of the adaptations.

In a paper entitled "From Buttercups to Monk's-hood,"[10] Grant Allen follows a regular flower, like Ranunculus, through its transformations into an irregular form, like Aconitum. He says: "The secret of the monk's-hood depends, in the first place, upon the fact that the flowers are clustered into a spike instead of growing in a solitary isolation at the end of the stem, as in the common buttercups. Now, Mr. Herbert Spencer has pointed out that solitary terminal flowers are always radially symmetrical, and never one-sided, because the conditions are the same all around, and the visiting insects can light upon them equally from every side. But flowers which grow sideways from a spike are very apt to become bilaterally symmetrical; indeed, whenever they are not so one can always give an easy explanation of their deviation from the rule." * * "As each bee would necessarily light on the middle or lower portion of the flower, he would begin by extracting the honey from the two upper petals; but it would be rather awkward for him to turn head downward and suck the nectaries of the three bottom ones. Hence, in course of time, especially after the flower began to acquire its present shape, the two top petals became specialized as nectaries, while the three lower ones gradually atrophied, since the colored sepals had practically usurped their attractive function." The views thus stated are not so fanciful as they may seem, as it is proposed to show in this paper. Instead of saying that the bee would "light on the middle or lower portion of the flower," I should say that he would light on the *middle*, and this will account for the fact that the nectaries are on the upper side. In those flowers in which the bee originally lighted on the *lower* part, the nectary is retained on the lower side and the upper nectaries abort.

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[10] Pop. Sci. Monthly, XXIII. 65-68, reprinted from Knowledge.

Starting with the turning of a regular flower to an horizontal position, what conditions make certain modifications possible or advantageous? In the first place, an erect, regular flower attracts insects equally from all sides, and offers the expanded petals as a landing to a bee approaching from any direction. The nectaries are as conveniently reached from one side as from another. The dehiscent anthers are arranged so as to apply pollen to a bee sucking any of the nectaries. Or the nectaries and anthers are both set in the way of a bee lighting on any side. The stigmas are as likely to touch the insect coming from one side as from another.[11]

Whatever have been the causes of certain flowers assuming a more or less horizontal position, the principal advantage seems to have been a restriction of the visitors to the most diligent bees. Most of the flowers adapted to wasps, flies and butterflies, or to miscellaneous visitors, are erect and regular. The change to a lateral position has had the effect of excluding miscellaneous visitors, and has given bees the advantage, since they cling to the flowers more readily.

If small, closely crowded flowers become horizontal they may be subject to all of the conditions which are supposed to have produced irregular flowers; but they lack the selective influence of insects, and the importance of insect agency is shown from the fact that such flowers remain regular. Insects have the same relation to small, crowded, lateral flowers that they have to such flowers in flat-topped inflorescences, *i. e.*, they fertilize them by brushing over them, even pollinating many which they do not suck. They visit the inflorescence, but do not visit the single flowers in such a way as to have any particular relation to them. No one would suppose that the florets of Compositæ would become irregular by becoming horizontal. The first condition, therefore, which is supposed to give rise to zygomorphy is that the flower must be large enough to offer some part of it as a landing to the insect.

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[11] See K. F. Jordan, Die Stellung der Honigbehälter und der Befruchtungswerkzeuge in den Blumen, 1886, 54, 4).

If one wished to understand the most important characters of zygomorphic flowers he might ask this question: How did some flowers come to be sternotribe with nectaries on the upper side, and others nototribe with nectaries on the lower side? These peculiarities seem to have depended on what part of the flower originally offered a landing to the insect. Insects seem to prefer the stamens and styles as a lighting place, and to have used them as such in all cases except those in which these parts were concealed in a tube. This may be because these organs were most horizontal, or came in the way of the lower petals, and because the pollen which they bear is often the object of the visit.

According as the original characters of the flowers are supposed to favor the development of sternotribe or nototribe zygomorphy, we will consider flowers in two divisions: 1. Polypetalous (including monocotyledons), shallow gamopetalous and deep gamopetalous flowers with exserted stamens and styles. 2. Deep gamopetalous flowers with included organs.

Carlinville, Ills.

Notes on structures adapted to cross-fertilization.

AUG. F. FOERSTE.

(WITH PLATE VIII.)

Silene Pennsylvanica is proterandrous; the shorter stamens alternating with the petals maturing first, then the longer stamens. After the anthers are effete the styles separate, become hairy along one side and are ready for pollen. The cup beneath the ovary formed by the top of the anthophore forms a nectary, from which the honey may flow at times into the calyx tube below; owing to the length of this tube the flower would seem more adapted to fertilization by butterflies, but bees were most frequently observed. The crimson corolla turns bluish purple at the crown teeth as soon as the styles become effete, a sign for insect visits to cease.

Silene regia has scarlet flowers; the change of color in the crown is far less marked. The stamens are all inclined to one side, the other side giving easy access to the nectary. The tips of the styles turn around into a loose coil, leaving the stigmatic portion on the outside of the coil directed slightly upwards, as though to insure more ready contact with the same on the part of visiting insects.

Sabbatia angularis secures the same effect by a moderate twisting of the stigma lobes, which causes the stigmatic surface to form a spiral about the lobes. In the stamens, also, the anthers, erect at first, become coiled at maturity, the coiling keeping pace with the dehiscence, which begins at the top, the top of the coil always keeping a fresh surface of the pollen exposed.

Psoralea Onobrychis has blue-purple flowers, with a greenish tinge on the center of the standard; length 4 or 5 mm.; visited by smaller-sized bees. The petals of the keel are not joined to one another, but are attached to the wings, being depressed with the same when bearing the weight of visiting insect, and at such times leaving the stamens and style exposed above the keel. Upon the pressure being released, the keel again springs up into its place.

Desmodium canescens has purplish-lilac flowers, with two whitish spots at the base of the standard, surrounded by a ring of dark purple, and serving as a guide to the opening of the flower beneath. The fact that the tenth stamen is free is *a priori* evidence of the existence of honey. The two petals composing the keel are each notched toward their base in such a manner as to leave a short projection on the outer side of the same. These projections fit into a groove in the lower part of the standard. When thus fitted the keel lies in tension, being held together around the stamens as long as the projections are held together in the groove of the standard. When a bee alights on the flower it thrusts its sucking tube beneath the standard, and in so doing spreads the keel apart, frees the projections of the keel from the grooves in the standard, and, with a quick jerk, keel and attached wings fly downward, leaving stamens and stigma in contact with the body of the intruder. The parts do not return to their former position, but change rapidly to a bluish tinge, indicating that the flowers are empty.

Lespedeza violacea has almost sessile, green, inconspicuous or minute cleistogamous flowers, chiefly in the lower axils, which do not expand, are fertilized in the bud, and are the chief flowers to produce seed. Conspicuous blue-purple flowers from the upper axils bear seed occasionally, and are adapted to cross-fertilization. The keel and wings when depressed generally take their former positions again as in *Psoralea*, but often they do not, thus leaving the stamens and stigma exposed. The bearing of cleistogamous flowers has made accurate action of the keel less necessary.

Tecoma radicans does not occur wild except within the range of Trochilus colubris, our common humming-bird. The frequent visits of this bird to the flowers of the trumpet creeper are well known, and, indeed, it seems to be the only visitor welcomed. The corolla is 7 or 8 cm. long, 2 cm. across at the throat, narrowing to 3 mm. along the lower 2 cm. of its length. Bees crawling in find the tube too narrow below. None but the largest moths have probosces long enough, and for those that have the position of the flowers seems not to be favorable. The stamens are didynamous, both pairs lying near the roof of the corolla tube, stamens of the same pair uniting slightly at their tips, the anthers being directed downward, exposing the pollen. The style extends above and beyond them, the stigmas lying anterior to the longest stamens. The flower being synacmic, cross-fertilization is secured by the sensitiveness of the stigma lobes, these closing in 7 to 10 seconds in young flowers on being disturbed. Older flowers often require 30 or 40 seconds, even more, such slow action being manifestly insufficient. But rapidity is apt then to be no longer necessary, the pistil usually being already fertilized.

Mimulus alatus has a similar arrangement of stamens and style, but the flowers being synacmic, the stigma lobes often in contact with the style, insect visits infrequent, cross-fertilization is not insured. The length of the tube makes the honey inaccessible to smaller bees. The flowers are violet-purple in color, with two hairy ridges on the lower lip, separated by a groove leading to the proper entrance. In albino flowers the entrance is darker, tinged with purple.

Mimulus ringens is essentially the same.

Scrophularia nodosa is proterogynous, as is well known. In the bud both stamens and style lie along the lower side of the corolla, curving upward anteriorly. On development the style first moves forward in position, and after fertilization continues in the same direction until it laps over the lip below. The stamens then take up the same motion. This simplicity of motion is in marked contrast to the advancing and retreating motion of stamens and styles in most Labiatæ.

Ruellia strepens has blue-purple flowers 3 cm. long, contracted rapidly below, the lower half being so narrow as to shut out all insects having sucking organs less than 13 mm. in length. The honey is secreted from a gland at the base of the ovary. The didynamous stamens are scarcely exceeded in length by the style, whose stigma is unequally lobed, the lower lobe being down-curved and often coming in contact with the upper anthers. The corolla has stripes of darker purple leading into the tube, serving as guide marks. The corolla lasts for only one day, easily falling off if disturbed. There is no structure insuring cross-fertilization.

Pycnanthemum lanceolatum has dense clusters of small white flowers, spotted with purple. Although labiate, the effect is rather that of a four-lobed corolla; the moderately didynamous stamens seem placed at the four sinuses of the same, and the style has a nearly central position. The stamens mature first, and may still contain pollen when the stigmas become receptive, although as a rule they grow effete at an earlier date. While the proterandry is not well marked, and its honey but poorly defended from general depredations, the plant is remarkable among our common Labiatæ for the great variety of insect visitors, as indeed its open structure might suggest. The most frequent visitors among these are various bees, wasps, flies, and unknown dipterous insects. Although bees visit this plant and Scrophularia nodosa alike, I could rarely succeed during the same trip in winning them from one plant to the other by holding it in their path, although there was no trouble in winning them over to plants of the same species.

Monarda fistulosa in the bud has stamens and style erect, the latter seeming the longer, but being soon overtopped by the stamens, which mature first. As they grow effete, the style ascends, surpasses the stamens in length, spreads out the lobes, and is ready in its turn. Bees, in visiting the flowers, come in contact with the anthers and stigmas chiefly on leaving the plant, rarely touching the same while gathering the honey.

Brunella vulgaris has flowers whose upper lip is violet, and the remainder white. The anthers mature first; later the stigmas open so as to stand just above and a little behind the anthers. The sterile tooth seems intended to keep the anthers forward away from the stigma; in the lower pair, where this is not necessary, the size of the teeth is much diminished. A bee entering the corolla touches the anthers first, pushing them back, and receiving fresh pollen. At the same time the stigma is being brought in contact with the old pollen as the bee presses it on its way in. So a somewhat similar result to that produced by different times of development is secured. The upper pair of anthers, at first close together, separate later, as if to avoid contact with the stigmas. Various gradations to flowers fertilizing themselves in the bud occur, in some of which the corolla never opens.

Stachys cordata in the bud has style and filaments curved forward beneath the lower lip. The stigmas are already separated, but not matured. When the flower opens the outer stamens stand before the inner ones, and the style lies behind them all. When the outer stamens have shed their pollen they move backward under the upper lip, and the inner stamens move forward to shed their pollen in turn. These also take their position under the upper lip, and the style takes their place. The stigma lobes have now separated more and are mature. The stamens, as seen, take up their position under the upper lip when effete, and do not move outward as recorded in S. palustris. The stamens have but one motion, *i. e.*, backward. When the outer stamens move backward, the upper lip does so likewise, and this makes it appear as though the inner stamens moved forward a little. Bees fertilize the flower.

EXPLANATION OF PLATE VIII.—1. *Psoralea Onobrychis*; *a, b*, anterior and lateral view; *c*, a lateral view, the petals of one side being removed; *d*, a petal of the keel and one of the wings attached.

2. *Lespedeza violacea*; *a, b*, anterior and lateral views; *c*, the andrœcium with the tip of the style projecting.

3. *Desmodium canescens*; *a, b*, anterior and lateral views; *c*, flower with the keel sprung; *d*, andrœcium with the style projecting.

4. *Scrophularia nodosa*; *a, b*, horizontal and vertical sections of a bud.

5. *Mimulus alatus*; *a*, the flower; *b*, a vertical section; *c*, an horizontal section seen from below.

6. *Silene regia*; *a, b, c*, successive stages in the coiling of the styles.

7. *Monarda fistulosa*; *a, b*, female and male states.

8. *Pycnanthemum lanceolatum*; *a, b*, male and female states; *c*, lateral view of male state; *d*, vertical section of the bud.

9. *Brunella vulgaris*; *a*, vertical section of bud; *b*, tip of style and stamens enlarged.

10. *Tecoma radicans*; *a*, horizontal section seen from below; *b*, vertical section of bud.

11. *Ruellia repens*; *a*, vertical section of flower; *b*, the stigma.

12. *Stachys cordata;* *a*, outer stamens mature; *b, c, d*, inner stamens mature; *e, f*, style in position, stigmas mature.

13. *Brunella vulgaris;* *a*, the flower; *b*, tips of the style and stamens enlarged.

All figures are one-third larger than nature.

Cambridge, Mass.

Description of a new fossil species of the genus Chara.

F. H. KNOWLTON.

Fossils that are now known to belong to the genus Chara were described by Dufourny de Villers, under the name of Vortex, as long ago as 1785.[1] They were regarded by him as small sea-urchins. Later, in 1807, Lamarck[2] described additional forms, under the name of Gyrogonites, which he regarded as minute univalve molluscs. This view obtained quite wide acceptance, and occurs in conchological works of the period,[3] and it was not until 1810 that Léman[4] first recognized and pointed out their true nature. Since that time upward of forty species have been recognized by paleobotanists, mostly from European localities. The only American species, so far as I can learn, is the doubtful *Chara* (*?*) *glomerata* described by Lesquereux[5] from the Green River group at Florissant, Colorado. As this species is founded upon leaf impressions, it lacks the precision which characterizes these species established upon the sporostegia or "fruits," as they are universally called by paleobotanists. These fruits are not absent from American deposits, as I am informed by Dr. C. A. White, of the United States Geological Survey, who has collected or observed them at various localities in the western territories; but they have generally been overlooked or neglected by collectors. I describe below a species which appears to be new.

Chara compressa n. sp. (figs. 1, 2).

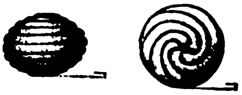
Fig. 1. Fig. 2.
CHARA COMPRESSA, n. sp.

Fruit (sporostegium) longitudinally much depressed, the height nearly one-fifth less than the width; apex obtuse or even slightly depressed; number of spirals, as observed in side view, ten.

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[1] Mem. l'Acad. Jun. 1785.
[2] Ann. d. Mus. d'hist. nat. vol. ix, 1807, p. 236, pl. xvii, fig. 7.
[3] Denys de Montfort. Conchylologie systematique.
[4] Ann. d. Mus. d'hist. nat. vol. xv, 1810, pl. 23. fig. 12.
[5] Cretaceous and Tertiary Floras, 1883, p. 135. pl. xxi. fig. 12.

Collected by Dr. C. A. White, two miles west of Wales, Utah, near old coal opening. The formation from which this species comes is the Wasatch group, the extreme lower member of the Tertiary, regarded by Dr. White as the equivalent of the Bitter Creek group of Powell, and the Vermillion Creek group of King. The matrix is a dark gray shale, weathering nearly white. The fruits are exceedingly numerous, and, in the weathered specimens, stand out in full relief, as they are much harder than the matrix.

This species bears considerable resemblance to some of the species described by Watelet[6] from the Paris basin, particularly *Chara depressa* and *C. onerata*. It differs from the former, which has only seven turns of the spiral visible in side view, and from the latter by its smaller size and also in the number of turns.

U. S. National Museum.

BRIEFER ARTICLES.

Veronica peregrina.—It may not be safe to lay it down as a rule, but there is no doubt in my mind that when we find almost every flower on a plant fertile, that plant may be classed as a self-fertilizer. It may be that cross-fertilization is a benefit to the race in the long run; the fact remains that where flowers are so arranged as to require external agency in pollination, the agents often fail to do the work, and numberless flowers are infertile. It is said by those who believe clover requires cross-fertilization that the flowers are barren in New Zealand and other places where the proper insect agents do not exist.

Almost all our common weeds, from this stand-point, would be self-fertilizers. Rarely, indeed, does a flower fail to produce seed. When we examine them closely we find that they are often so arranged that self-pollination alone is possible. Veronica peregrina is a good illustration. The two stamens are alternate with the upper lobe and bend over so that the anthers seem deposited on the apex of the stigma. The pollen-sacs burst almost simultaneously with the expansion of the corolla. The stigma is in receptive condition at the same time, and becomes covered with own-pollen. It would be difficult to conceive of any better arrangement for securing self-fertilization, aside from cleistogamy.—THOMAS MEEHAN.

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[6] Descrip. d. pl. Foss. d. Bassin de Paris. Paris, 1866. pp. 50-56, pl. 15.

The paraffin-imbedding process in botany.—Within a few months there have appeared two articles[1] on this subject, and as the writer has been devoting some attention to it lately it may be of interest to some of the readers of the GAZETTE to state briefly the results obtained. It was found convenient to combine to some extent the methods given in the articles referred to, as neither was found in all respects satisfactory, and some simplifications of the processes were made which were found advantageous.

The experiments were made upon the germinating macrospores and the young embryos of Pilularia globulifera, and the results obtained warrant a very strong recommendation of the imbedding process where the sectioning of very delicate tissues is necessary; indeed, when the results thus obtained are compared with the imperfect and uncertain methods ordinarily used in such work, no one who has used both will, I think, hesitate as to their comparative merits. With the firmer plant tissues there is usually no necessity for any imbedding process, and owing to the time and care necessary to successfully apply this method it is not to be recommended in such cases.

In regard to the best hardening agents Schönland and Moll disagree, the former recommending alcohol, which Moll does not consider satisfactory, prefering chromic acid or the mixture of chromic, osmic and acetic acids used by Flemming. There is no question that for many purposes absolute alcohol is to be preferred, owing to its convenience and the perfection with which it ordinarily preserves all plant tissues. With mixtures of chromic, picric or osmic acid thorough washing is necessary after hardening; but, as Moll rightly remarks, where cuticularized cell-walls are present it is extremely difficult to get the paraffin to penetrate such membranes, whereas it is much easier where fixing solutions containing chromic acid are employed. A practical illustration of this was found in the very thick-walled macrospores of Pilularia.

After the material is thoroughly hardened, and in the case of alcoholic material allowed to remain for 24 hours in borax-carmine, it is treated as described by Schönland.[2] For the gradual transfer from 30 per cent. to absolute alcohol the Schultz apparatus[3] was found most serviceable.

The following method of imbedding was found practical and simple: A small paper box is made by taking a strip of pretty firm paper and winding it tightly about an ordinary cylindrical cork, fastening the paper with a little gum-arabic and holding it in place with a pin until dry. On taking out the pin the paper cylinder can, of course, be slipped off the cork. The box is completed by cutting out a round piece of paper of exactly the size of the cylinder and putting this into the cylinder as the bottom of the box. The object to be imbedded is placed horizontally upon the bottom and the melted paraffin poured over it, after which the whole is placed in a shallow, flat-bottomed vessel filled with melted paraffin. Thus there is no possibility of the paraffin's escaping, which otherwise it is almost impossible to prevent, and there is also no necessity of handling the objects after they are once in the paraffin, which, in the case of small objects, is a great advantage. In case the objects are displaced in pouring the paraffin over them it is a simple matter to adjust them, using a heated needle for this purpose.

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[1] Schönland, Bot. Centralblatt, No. 22, 1887. Moll, BOT. GAZETTE, Jan. 1888.

[2] L. c., also BOT. GAZETTE, July 1887.

[3] Strasburger, Bot. Prak., II Edit.

In order to insure thorough saturation the objects were usually left over night in the melted paraffin, and then, as in the articles mentioned, quickly cooled to avoid the formation of bubbles. The vessel containing the paper boxes may be exposed to the air for a few minutes until a thin film has formed over the surface of the paraffin in the latter, when these may be quickly lifted out and plunged into cold water. As soon as the paraffin is thoroughly hard, the pasted seam in the paper cylinder may be loosened with the blade of a knife or scalpel, when it will be found that the paper separates readily from the inclosed paraffin, and on removing the bottom of the box in the same way the result is a solid cylindrical block of paraffin with the object to be cut lying horizontally close to the smooth lower face, so that the sectioning is easily regulated.

Schönland[4] recommends paraffin with a melting point of about 45° C., but I found this much too soft to cut well, and prefer, as Moll recommends, a harder sort, melting at about 50° C. Schönland again says that a temperature above 50° C. is to be avoided, but in no case have I found that a temperature of 50°–55° C. was in the least degree hurtful.

For sectioning the rocking microtome used by Schönland was employed and found in every way satisfactory. With it it is possible to obtain series of sections, a very desirable thing in embryological investigations.

Moll[5] describes fully the fixing processes, but my experience has been that it is not desirable to hasten the staining process. Safranin was mainly used, and the best results were had by allowing the sections to remain for about twenty-four hours in a very dilute watery solution. At the end of this time they should be deeply stained. The slide is then plunged in absolute alcohol until the excess of the color is removed, and when this is accomplished and most of the alcohol has been removed from the slide with a cloth or blotting paper, taking care of course not to touch the sections, a few drops of xylol is applied and allowed to remain until the sections look perfectly transparent, when a drop of Canada balsam dissolved in xylol or chloroform may be applied and a cover-glass put over the preparation, which is now complete.

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[4] L. c. [5] L. c.

The employment of soft paraffin in order to make the sections adhere, as described by Schönland, is quite unnecessary, as the sections adhere perfectly without this; indeed, it is much easier to get a good ribbon of sections without the soft paraffin than with it, owing to the difficulty of perfectly removing the surplus soft paraffin.—DOUGLAS H. CAMPBELL, *Berlin.*

Rules for the Botanical Exchange Club.—It having been decided to organize the American Botanical Exchange in connection with the national herbarium in the Department of Agriculture, the botanist of the department will act as director of the Exchange, and the following rules will be followed in its management until further notice:

1. Persons desiring specimens are required to contribute a number regarded as equivalent in value to those called for. The specimens wanted in return may be selected when the others are sent or at any time afterward.

2. The number of the specimens returned will be at the discretion of the director, and will depend on the rarity and condition of those furnished. In the case of well known plants they will probably nearly equal the number sent.

3. In the case of small plants, several specimens should be furnished under one number, as in such cases a single specimen is not a satisfactory representation of the species.

4. Specimens may be called for by species or genera, or by the locality from which they are wanted. To save time the species may be indicated by the numbers which they bear in any well known American catalogue, the name and the edition of the catalogue being given.

5. Specimens sent must be accurately named, and bear the date and locality of collecting, with the name of collector. Little value will be attached to specimens which are imperfect or poorly prepared.

6. The director of the Exchange will reserve the right to indicate his judgment in cases where specimens seem improperly named; but the responsibility of the names will in other cases rest with the original sender.

7. Well prepared specimens of all flowering plants and vascular cryptogams will be received, and also specimens of thallophytes, the last mentioned to be under the charge of the Chief of the section of Vegetable Pathology. Hereafter lists will be published of plants especially desired, or of which no more specimens are needed.

8. An account of the specimens received from each person will be kept, and of those sent in return, and, also, of any other specimens which he desires or can supply. The Exchange will thus serve as a bureau of information upon this subject.

9. Conditions of membership: Any botanist may become a member of the Exchange Club by paying annually to the director the sum of two

dollars; this money to be used in payment for postage, printing and incidental expenses.

10. Address specimens and communications to the director of the Exchange.

DR. GEO. VASEY,
Washington, D. C. *Botanist, Department Agriculture.*

EDITORIAL.

THE NOMENCLATURE of vascular plants seems to be in somewhat of a ferment. The law of priority every one recognizes, and that mile-stone in our progress has been passed long since. The application of the law is the question just now, and one that must be settled. The way of settling it is of far less importance than to have it settled. Fixity is what we must have, and we must have it even at the expense of some of our most cherished prejudices. Shall the law of priority apply only to the combined generic and specific name, or to the specific appellation as well? All of us have prejudices, backed by very good reasons as well as sentiment, in favor of one or the other of these views. But it will never do for us to go ahead in sublime indifference of each other. To what a chaotic state would such a proceeding lead? It is hardly the thing for a monographer to carefully study some group and publish his results in a paper in which relationships are the chief thing, and names of very minor importance; and then for some catalogue-maker to hunt through the synonymy and give different names to many of the plants in a publication in which names are the chief things. We must work together, or justice will never be done to those to whom justice is due. It has occurred to us that we could reach some uniformity of action, if not of opinion, that would save American botany at least from the chaos toward which it seems drifting. Prejudice and sentiment, and the names of plants, are all of so much less importance than uniformity that they ought to be laid aside for the sake of any sort of an agreement. Would it not be a feasible thing to have this subject discussed by the Botanical Club next August at Cleveland? Some plan might be devised by which the opinions of all working botanists could be obtained, and upon this basis some mutual understanding might be reached. At any rate, a full discussion would do no harm.

OPEN LETTERS.

The Exchange Club.

My attention has been called to an article of Mr. A. A. Crozier's in the last number of the GAZETTE, concerning the proposed Botanical Exchange. This article did not emanate from the committee. The objectionable point in the article seems to be an obscure intimation that under certain circumstances there might be no fees and that the interchange of specimens might be made free of postage. This idea arose from the fact that this department often franks packages of plants which are sent as contributions to the herbarium, and we were discussing the question whether this could be made available for packages where only a certain percentage of the specimens were to be so applied. But such a plan would be open to objection, and will not be entertained. Small packages are very cheaply transmissible through the mails, and botanists will be glad to avail themselves of such advantages. A set of rules for the Exchange is published in this number of the GAZETTE. GEO. VASEY.

Department of Agriculture, Washington.

What shall be done with our Prosartes?

The books give eight species as belonging to the American genus *Prosartes*, which would rest there undisturbed did not Bentham, in the *Genera Plantarum*, refer them all to Salisbury's Asiatic *Disporum*. The two genera are certainly exactly alike to all appearance, but had been supposed to differ in the position of the ovules, the Asiatic species having them pendulous from near the top of the cells, and the American ascending from near the base. But Bentham states that in one Himalayan species and in our P. trachycarpa he had found the ovules attached laterally near the middle—which surely leaves very slight basis for two genera. This is a pity, as it is an advantage to keep the groups apart on account of their difference of habitat, the generic name at once revealing the home of any species. Whether Mr. Bentham was right I am not enough of a botanist to decide, even if I had the specimens for an independent comparison of the species. Botanists in a small way like myself must be content under such circumstances to adopt the master's decision without question.

Taking it for granted, therefore, that *Prosartes* can no longer stand, the question arises, what authority is to be cited for the species when transferred to *Disporum?* Inasmuch as Mr. Bentham is known with certainty and by his own statement to have worked up the *Liliaceæ* for the *Genera Plantarum*, and there transfers the genus *Prosartes* to *Disporum* bodily, without exception or question, it would naturally seem right to cite him as the authority for the several species. Our species, then, should be written as they are given below in column A. But the *Genera Plantarum* was a joint work, and though the orders were portioned out so that some were revised by Mr. Bentham alone, and others by Dr. Hooker, yet the whole was so explicitly indorsed by both, and was so published under the names of both, that no part can be attributed exclusively to either. Consequently, instead of crediting the species to Bentham alone, they must be given to Bentham and Hooker, as in column B.

But now it is affirmed that this will not do: that Bentham and Hooker can not be cited as authority for a name which they never wrote; that in all Bentham's or Hooker's, or Bentham and Hooker's, writings, no mention can be found of a species *Disporum Menziesii*, nor of any of the others excepting *D. trachycarpum*, which alone is expressly mentioned in the *Genera Plantarum*. As for the rest, it is asserted that we do not know, and have no right to infer and say, that if Bentham and Hooker had written out the list they would have done it as below, for they might have united or dropped some of the species, or found some reason to alter the specific names, so that we are "making them say what they do not say," and virtually falsifying the record in citing them as authority. It is asserted that this so-called "authority" is simply an abbreviated citation of the place where the name itself is first to be found. Since, therefore, this is the first time, so far as I know, that these names have actually appeared in print, this article and its writer will for good truth's sake need to be cited, and the names must accordingly stand as in column C. This, certainly, is very gratifying to one's vanity, to know that through all time these names will go down with my name attached, and that by this unimportant article I have attained to a certain small degree of cheap immortality in the records of science. But, after all, this effort at truth appears to me to be rather like straining at a gnat and doing the other thing. For however much it may be insisted on that this "authority" is only an abbreviated citation, I am sure that those who make the assertion must be conscious at heart that the doctrine is essentially a fiction, got up in recent times for a purpose. The name of the person which is attached to the name of a plant is always spoken of as the "authority" for the plant-name. We have no other designation for it, and for the reason that the word expresses exactly the idea. The name is intended to indicate the person upon whose authority the plant-name rests, the one who first made a *Disporum* of *Prosartes Menziesii*, for example. That is the very point that we wish to know; no one cares to know who it may be that after the change is authorized chances to be the first to make use of the name. Now, in this case, I am no authority for the transfer. and am not the author of *Disporum Menziesii;* I am simply blindly following Bentham's lead, and expressing in words what he had previously said in fact. It appears to me a worse falsification of the fact to cite "N. or M." as authority in this case than it is of the record to cite "Benth. & Hook.," for it is denying that they made a *Disporum* of *Prosartes Menziesii.* As truly as the whole must include all its parts, and as the general also includes the particular, so truly did they make a *Disporum Menziesii* of *Prosartes Menziesii* when they said that *Prosartes* belonged in *Disporum.* It makes no difference that there might be already a D. Menziesii, and that there should not be two species of the same name in a genus, for there are actual cases of that very thing; nor does it make any difference what other questions there may be as to validity of species, correctness of nomenclature, or whatever else. All these questions can remain in abeyance as well under *Disporum* as under *Prosartes,* the one statement holding good that all the known and reputed species of *Prosartes,* such as they are, are now, in the judgment of Benth. & Hook., species of *Disporum,* subject to the same criticism in that genus as in the other.

Suppose, now, that. instead of adopting their conclusion. I were here combating it and refusing to accept it, but had occasion in the course of my article to name the species as if under *Disporum.* According to this rule I must still be cited as authority for the species just the same. Absurdity in this matter could not easily go much further, yet this does not seem to me very much more absurd than the other.

To take another example, Benth. & Hook. transferred Engelman's cruciferous genus *Dithyræa* to *Biscutella,* stating, simply, that there were two species, but not giving their names. Dr. Watson, in his "Index," accepting their identification, entered the two species B. Californica and B. Wislizeni, and cited honestly, as he doubtless thought, "Benth. & Hook., *Gen. Pl.,*" as his authority. It has been said that this is wrong, as it makes Benth. & Hook. say what they do not say, and that the only absolutely correct thing now to do is to cite Watson as authority for the species (supposing that these names first appeared in the "Index," which happens not to be the case). But this, again, is just as much a falsification of the record as the other, making now Watson say what he does not say, and representing him as claiming authorship of the species—the very thing he is careful not to do. A correct citation of the "Index" would be "*Biscutella Californica* Benth. & Hook , ex Watson, etc.," which shows exactly what Watson says. This, in the ordinary course of abbreviation, becomes "*B. Californica* Benth. & Hook.," just as we cite Nuttall as authority for numerous species which he never published, "Nutt." being a convenient abbreviation of "Nutt., ex Torr. & Gray," or "Nutt., ex DC. Prodr.," etc.

This instance illustrates, also, another point, viz.: the difficulty of determining with certainty in any case who was really the first to use the new name. It may have first appeared in an overlooked catalogue or journal, or other out of the way publication, and any authority supposed to-day to be correctly given is liable to be ousted to-morrow. Not a few cases have occurred where a writer in the supposed application of the rule has innocently written his own name as authority for a species, to find a little later that some happier mortal was in advance of him.

But to return to our new species of *Disporum*. They are now, according to rule, under the assumed authorship of "N. or M.," and the absurdity of perpetuating an anonymous authority of this or any sort is evident. What shall be done? If we can not go back to "Benth. & Hook." we must go forward, and the only alternative that occurs to me is to cite the "GAZETTE." Under the usual formula "Coult. Bot. Gazette," therefore, the names will now appear as in column D. That looks well. But why single out one from among the worthy editors of the GAZETTE to father these poor foundlings? It can not be denied that they have an equal claim upon all three, and that "Arthur, Barnes & Coulter" is the only legitimate resource. In the necessary process of condensation this becomes inevitably A. B. C., and thus the column E is filled, and, having reached this conlusion, we have found at last an answer to the question with which we started.

A.	B.	C.	D.	E.
Disporum Menziesii, Benth............	Benth. & Hook.	N. or M.	Coult.	A. B. C.
Disporum lanuginosum, Benth........	Behth. & Hook.	N. or M.	Coult.	A. B. C.
Disporum maculatum, Benth.........	Benth. & Hook.	N. or M.	Coult.	A. B. C.
Disporum trachycarpum. Benth......	Benth. & Hook.	Benth. & H.	Benth. & H.	Benth. & H.
Disporum Hookeri, Benth..............	Benth. & Hook.	N. or M.	Coult.	A. B. C.
Disporum trachyandrum, Benth......	Benth. & Hook.	N. or M.	Coult.	A. B. C.
Disporum Oreganum, Benth...........	Benth. & Hook.	N. or M.	Coult.	A. B. C.
Disporum parvifolium, Benth.........	Benth. & Hook.	N. or M.	Coult.	A B. C.

N. OR M.

From Northern Idaho.[1]

From Camp Lakeside, at the south end of Lake Pend d' Oreille, Mr. Leiberg writes:

"I send by this mail a package of seventy species of mosses. They have been nearly all collected during the past three weeks, within a radius of two miles of this place, which is our winter camp. I have not yet collected at any great heights, as the snow lies several feet deep on the high peaks and ridges that surround us here. In about a month we will be able to cross over into the great North Fork of the Cœur d' Alene River basin, which lies immediately to the east of us. This basin abounds in high peaks, deep, dark cañons and chasms, waterfalls and cascades—just the conditions best suited to produce a flourishing growth of mosses, and I expect a rich harvest in these places. While this is a difficult country to collect in, one has at least the satisfaction of knowing that he is on ground on which *no one* has ever before collected. . . . .

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[1] We "open" some private letters from Mr. John B. Leiberg, who is prospecting in Northern Idaho, to give our readers some glimpses of his botanical observations. Although almost constantly in the saddle, Mr. Leiberg finds time to collect the plants of the region, and has sent in a number of new species.—EDS.

"The moss flora seems to be wonderfully well developed here. To date I have observed over 110 species within a radius of four miles. I do not think it would be an overestimate to count upon at least 500 species of mosses for Kootenai county. But it must be remembered that this county covers a large area—nearly 7,000 square miles—and that nearly all conditions of climate and soil in the temperate regions of North America are found here. Lichens and fungi also abound in these excessively damp woods. . . . .

"At the northeast angle of the lake, about fifty miles from here, where Clark's Fork of the Columbia enters the lake, there exists a great subaqueous bank composed of the silt carried down by the river. Usually, during the months of August, September and October, the water is only two to three feet deep over some six square miles of this bank, and here grow and flourish Charas as possibly in no other place in the United States. The greater portion of the lake is without vegetation (except diatoms and desmids, which are found nearly everywhere), as the water averages 1,000 feet in depth; but wherever a shallow spot exists Charas grow the year around, for the waters of the lake freeze only in a few circumscribed localities. . . . .

"For many months whenever collecting I have searched for fertile specimens of Neckera Menziesii, but always in vain, until I had begun to think that it never fruited in this latitude Judge of my surprise and delight when, a few days ago, I discovered on the bare face of a huge granite ledge a large tuft of N. Menziesii fruiting abundantly! This find has stimulated my endeavors to find fruiting specimens of the other sterile mosses I have collected here. . . . .

"As the season advances the species of Hypnum are coming to the front fast. There is an immense variety of this genus around here, and I add some every day to my collections. . . . .

"I am glad to hear that the water-lily was a new one [Castalia Leibergi, described in the May number of the GAZETTE], but the most remarkable circumstance is that so conspicuous a plant should have remained undiscovered by western botanists. It is hardly to be supposed that the insignificant little pond in which I found it growing is its only habitat. In this particular pond it is very abundant, growing with Nuphar polysepalum and Brasenia peltata among others. . . . ."

CURRENT LITERATURE.

Flora of the Hawaiian Islands.[1]

Insular floras are always peculiarly interesting, and few are more so than that of the Hawaiian Islands. Lying so far removed from all continents, these islands present important problems to the geographical botanist. During a residence of twenty years Dr. Hillebrand unremittingly studied the Hawaiian flora, thoroughly exploring the whole region and cultivating very many of its native plants. This book, embodying as it does the results of such protracted study, is more than a mere manual, for it contains most valuable notes upon the peculiarities of the flora and offers many suggestions as to its origin. It is a pity that the author was not spared to correct the proof-sheets and to develop his notes, which are given as mere memoranda, but the editing has evidently been very conscientiously done by his son, assisted by Professor Askenasy, of Heidelberg. An introduction of twenty pages gives a general account of the position and nature of the Hawaiian Islands, as well as the striking features of its flora. Then follows Mr. Bentham's "Outlines of Botany," from his British and Colonial Floras, with a good glossary. The diversity of conditions, and hence of the flora, of the different islands is so great that in our limited space we can give no account of it, although it is presented in a very clear and interesting way. Five different zones of elevation are described, called the "lowland zone," mostly grass-covered after rains, with isolated clumps of trees; the "lower forest zone," with rather open woods, characterized by the pale green foliage of Aleurites Moluccana; the "middle forest zone," within the region of the clouds, and luxuriant in trees and jungle, and with a great exhibition of Lobeliaceæ, "the peculiar pride of the flora;" the "upper forest zone," characterized by stunted trees; the "bog-flora" of the high table-land of certain islands. A comparison with other floras brings out the striking difference in the great number of varieties in all the species of the principal genera, as though nature had run wild in the production of diverse forms. These islands seem to be the only ones of the Polynesian group which contain a large proportion of indigenous plants with American affinities, while Australian types are wanting or very scantily represented. Southern Asiatic types are few, and many of them have probably been carried over by the aborigines. The entire absence of gymnosperms is one of the notable features of the flora, as well as the low size of all the trees, none but the cocoa-nut palm exceeding 100 feet, the usual height of the largest trees being 50 or 60 feet. Nearly all the native plants are perennial and woody. This volume describes 844 species of phanerogams, representing 335 genera, and 155 pteridophytes with 30 genera, making a total of 999 species. It is believed that 115 of these species have been introduced since the discovery by Captain Cook in 1779, and 24 species by the natives in prehistoric times. This leaves 860 species as original inhabitants, of which no less than 658 are endemic, or over 75 per cent. Of this 653 endemic species 250 belong to endemic genera. Considering dicotyledons alone, over 85 per cent. of their species are endemic. This character is strikingly shown in Lobeliaceæ, of which 58 species are known, all endemic, belonging to 6 genera, 5 of which are endemic. It is needless to say that the volume abounds in new species, and illustrates in every page the fact that it deals with a long isolated flora.

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[1] HILLEBRAND, DR. WILLIAM.—Flora of the Hawaiian Islands: a description of their phanerogams and vascular cryptogams. Annotated and published after the author's death by W. F. Hillebrand. xcvi and 673 pp., with 8 maps, 8vo. Heidelberg: Carl Winter, University Bookseller, 1888. [Williams & Norgate, London. B. Westermann & Co., New York.]

The geological history of plants.[3]

It had been known for some time that a work was being prepared by Sir William Dawson on the geological history and development of vegetation, and its appearance was anxiously looked forward to, in hope that we should at last have an American work, illustrated by American material, and clearly abreast of the times. The work is before us, and, after a thorough examination, we can not repress a general feeling of disappointment that it is not what was expected from one seemingly so well qualified, although in some particulars it is very satisfactory, and must be of permanent value. The opening chapter deals with the evidences of the existence of plant life in the so-called azoic formation, and the facts adduced are of the most convincing nature. The presence of the immense beds of iron ore, which, so far as now known, can only be deposited in the presence of decaying organic matter, is a strong presumptive argument, as is also the presence of beds of graphite, which, according to Sir W. E. Logan, aggregate in the Laurentian a thickness of more than thirty-five hundred feet. The oldest unquestionable plant remains admitted by Dawson, from the Skiddaw rocks of Cumberland, are called by him Protannularia, since he regards it as being allied to the carboniferous genus Annularia. These are regarded not as algæ, but as Rhizocarps, and with the Protostigma of Lesquereux indicate the presence of the Rhizocarpeæ and Lycopodiaceæ in the Silurio-Cambrian. The supposed taxine wood first called Prototaxites by Sir William he now regards as probably the stem of a gigantic sea-weed, as was long ago pointed out by Carruthers. The problematical organisms, which have until lately been regarded as plants, Dawson concludes, with some of the European scientists, must probably represent the tracks or burrows of worms. Under this head he places the so-called genera Bilobites, Rusichnites, Paleophycus, Buthrotrephis, etc. In the Devonian, and particularly in the upper portion to which the name Erian has been given, the vegetation became more pronounced, and we find ferns, Equisetaceæ, Sigillarieæ, Lepidodendreæ, etc., in comparative abundance. We can not, however, agree with the author that the Taxineæ or yews extend into the Devonian, or, indeed, into the Carboniferous. The species described as Dadoxylon undoubtedly represents the wood of Cordaites, as is shown by the fact that they all possess an Artisia pith, slit-form bordered pores covering the entire radial walls of the tracheïds. Cordaites is a typical paleozoic genus which is allied to the cycads on one hand and the conifers on the other, and the characters as established by Grand 'Eury and Renault, who have so successfully worked up the European material, agree with all of Dawson's species Dadoxylon. The *Araucarites gracilis*, thought to represent the leaves of a species of Dadoxylon, is probably a species of Walchia, a Permian genus.

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[3] DAWSON, SIR J. WILLIAM.—The Geological History of Plants. Vol. LXI, Internat. Sci. Series. 12°. New York: D. Appleton & Co. 1888.

Another debatable point is the relationship of the Sigillarieæ. Since the admirable researches of Williamson on the internal structure, and the discovery by Zeiller of cones containing both microspores and macrospores, their position among the cryptogams, although possessing an exogenous mode of growth, seems to be clearly defined, and the prediction that it will ultimately be proved that there are two branches of the family, one coniferous and the other cryptogamous, is not likely to be fulfilled.

In speaking of the transition from cryptogams to phænogams Sir William thinks it probable that these have been their lines of connection, "one leading from the Lycopods by the Sigillarieæ, another leading by the Cordaites, and the third leading from the Equisetums by the Calamites." After making this unequivocal admission he makes haste to say: "I do not make these remarks in a Darwinian sense, but merely to state what appear to be the lines of natural affinity, and the links wanting to give unity to the system of nature." It seems almost incredible in this state of scientific thought that a denial of the doctrine of evolution, especially in a work on the development of vegetation, should be deemed expedient.

The remaining chapters of the work are devoted to Mesozoic and Tertiary vegetation, and as the deposits containing these happen not to be very well developed within the British provinces, the account becomes in consequence meager and incomplete; in fact, the omissions of the whole work "correspond," as has been said by another reviewer, "with the imperfections of the geologic record in the locality studied by the author."

The illustrations, about eighty in number, are, almost without exception, from earlier published works on Canadian plants by the author.

The Flora of Miquelon.

The double island off the south shore of Newfoundland known as Miquelon has been pretty thoroughly explored by Dr. Delamare, and the results of his collecting and notes appear in collected form in this admirable "Flora Miquelonensis."[3] Dr. Delamare has been assisted in the preparation of this little work by a number of specialists, some of whose names appear as joint authors. The flora contains a description of the topography, climate and superficial geology of the isle, extended remarks on the relative distribution of the phanerogams, with interesting notes on various matters. The introduced and cultivated species are indicated, and also species found by de la Pylaie. Of the cryptogams, the ninety-four species of mosses are treated at greatest length, and the list contains descriptions of several new varieties and one new species, *Dicranum Miquelonense* Ren. et Card., and a new sub-species of Rhacomitrium canescens, viz.: *R. Delamarei* R. & C. Only four species are extra-European. Five species new to North America are included in the list. Among Sphagnaceæ, out of the twenty species and sub-species common to Europe and North America, only four have not been found in Miquelon, which shows how unusually rich the island is in the peat mosses. Thirty-seven species of Hepaticæ, 126 of Lichens and forty-three of marine Algæ are also listed. In general, the character of the phanerogamic flora is strongly American (46 per cent.) and boreal, whereas the cryptogamic flora greatly resembles that of the mountains and northern parts of Europe. The island of Saint Pierre, a league away, which was long ago explored by de la Pylaie, receives but scant notice in this paper, which is an admirable contribution to geographical botany.

Our Native Ferns.[4]

It is quite fortunate that so soon after the destruction of the remainder of the second edition of this handy manual we are able to notice the third edition. The fact that the first edition was published no longer ago than 1881 is evidence enough of the value of this little book and that it has a place to fill. In the first edition 140 species of true ferns were described. This number is now augmented by nineteen, and three of the former species reduced to varieties. The fern allies receive the accession of one genus, Salvinia, and eight species, while three former species have been reduced in rank. The first ten chapters, that is about half of the book, deal with the life-history, structure and relationships of the pteridophytes. The latter half is occupied with condensed and accurate descriptions of the species, accompanied by well-made analytic keys which lead the user to within one or two species of the determination. This feature, for the purposes of such a book, is especially to be commended. Of much value also are the abundant references to the American sources of information about our native pteridophytes. The whole text is exceedingly satisfactory, and will do very much to stimulate the user to a closer acquaintance with our ferns and to make of him an acute observer, or even an original investigator. The typography is worthy of the text. It would have been a happy thing, however, for the new publisher to have improved the quality of a few of the illustrations.

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[3] DELAMARE, E., RENAULD, F., CARDOT, J.—Flora Miquelonensis: Florule de l'ile Miquelon (Amerique du Nord), énumération systématique avec notes descriptives des Phanèrogames, Cryptogames vasculaires, Mousses, Sphaignes, Hépatiques et Lichen. pp. 79. 8vo. Lyon: Association Typographique, 1888.

[4] UNDERWOOD, LUCIEN M.—Our native ferns and their allies, with synoptical descriptions of the American Pteridophyta north of Mexico. Third edition, revised. pp. xii, 156. figs. 35. 12mo. New York: Henry Holt & Co., 1888.

Minor Notices.

MR. WOODWORTH, working in Dr. Farlow's laboratory, has investigated the growing point of Fucus,[5] using F. furcatus first, and confirming his results upon F. vesiculosus and F. filiformis. While Reinke and Rostafinski found what they considered a group of cells, Woodworth sees a single initial cell, four-sided, wedge-shaped, with convex sides, the smaller upper end being rounded and the base truncated, with its greater diameter at right angles to the broad surface of the frond. Woodworth was able to observe the relations of the cells accurately by imbedding the tips of the fronds in paraffin and cutting ribbon serial sections, and his results are confirmed by their agreement with what is known of related species and cryptogams in general.

WE HAVE HAD many guesses, and some shrewd ones, as to whether our Sarracenias profit by their insect-catching arrangements. Dr. W. P. Wilson has undertaken to investigate these plants thoroughly. A preliminary report[6] of some work deals with the morphology of the leaves of our common northern and southern species. Both species form small early leaves unlike the mature ones. Those of S. purpurea are miniatures of the mature leaves of S. variolaris, and *vice versa*. This fact and the rudimentary character of its honey glands lead to the conclusion that S. purpurea is a retrograde development from S. variolaris. This conclusion is confirmed by the fact that S. variolaris secretes a considerable amount of a digestive ferment which dissolves the soft parts of insects, while S. purpurea produces but a trace of it.

OF LOCAL FLORAS, Milwaukee county, Wisconsin, has had more than a fair share. Mr. Lapham's assiduous collecting was supplemented by his permanent record in various lists of the flora of Milwaukee and vicinity. The last list by Mr. Wheeler,[7] curator of the Milwaukee public museum, includes 691 Phanerogams and vascular Cryptogams, of which 567 are indigenous to the state. 124 species are, therefore, introduced, of which 113 come from Europe, and probably many of them directly from Germany. The list is prefaced by some remarks on the topography and climate of the county. It does not seem to be founded upon preserved specimens, which is unfortunate.

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[5] WOODWORTH, W. MCMICHAEL.—The apical cell of Fucus. (Contrib. from Crypt. Lab. Harvard Univ. ix). pp. 9, pl. 1. 8vo. Reprinted from *Annals of Botany*, Feb., 1888.

[6] WILSON, W. P.—On the relation of Sarracenia purpurea to variolaris. p. 1. 8°. Proc. Acad. Nat. Sci. Phila., Feb. 20, 1888.

[7] WHEELER, W. M.—Flora of Milwaukee County. pp. 154-190. 8vo.—Extract from Proc. Nat. Hist Soc. of Wisconsin, April, 1888.

A PRELIMINARY catalogue[8] of the vascular plants growing within a hundred miles of New York City has been issued by the Torrey Botanical Club. The boundary line is quite an arbitrary one, but probably limits the work as well as if it was more natural. A list of ballast plants is also included, and presents a formidable array of foreigners who have landed upon our shores, the great majority of whom, it is to be hoped, will find no welcome. The noticeable thing about the catalogue is its innovations in respect to specific names, for which, we are told, the subcommittee on nomenclature, consisting of Messrs. Britton, Sterns and Poggenburg, "alone are responsible."

NOTES AND NEWS.

DR. CHARLES E. BESSEY, of the University of Nebraska, sails for Europe June 16 to spend the summer.

THE FIRST PART of the seventh volume of Saccardo's Sylloge Fungorum is issued, and will hereafter receive suitable notice.

MR. M. S. BEBB describes (with plate) Salix balsamifera in *Bull. Torr. Bot. Club* (May), and gives an account of its discovery in the White Mountains.

ARCHÆOPHYTON NEWBERRYANUM is the name of a supposed Archæan plant described (with plate) by Dr. N. L. Britton in *Annals N. Y. Acad.* iv., 123.

RECENTLY FIGURED North American plants in *Garden and Forest* are *Rosa minutifolia* Eng. (April 25), *Hymenocallis humilis* Watson (May 2), *H. Palmeri* Watson (May 16).

DR. H. H. RUSBY, of Columbia College, has distributed a reprint of his interesting paper, "Coca at home and abroad," published in the *Therapeutic Gazette* for March and May.

MR. GEORGE MASSEE has published a revision of the genus Bovista in *Journal of Botany* (May). The genus is credited with thirty-nine species, four of which are described as new.

THE REVISION of Scotch Sphæropsideæ and Melanconieæ by Prof. J. W. H. Trail is brought to a close with 223 species in the *Scottish Naturalist* for April. It is a list of species and habitats with a key to the genera, but without descriptions of the species.

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[8] Preliminary Catalogue of Anthophyta and Pteridophyta reported as growing spontaneously within a hundred miles of New York City. Compiled by a committee of the Torrey Botanical Club. xviii and 90 pp., with map. New York, 1888. Price, $1.

AN INDEX of the habitats of the fungi in Ellis' *North American Fungi*, cent. XI to XX., has been compiled and published by W. C. Stevenson, Jr. It will prove a great service to users of the work.

THE KEW BULLETIN for May contains information concerning ipecacuanha, Brazilian gum-arabic, Trinidad coffee, patchouli, Cochin China vine, Madagascar ebony and Shantung cabbage.

DR. CHAS. E. BESSEY has published a pamphlet entitled "Grasses and Forage Plants of Nebraska." It is of great interest to the farmers of that country, and contains twenty plates of the common grasses.

DR. HUBERT LEITGEB, well known for his classical researches on the Hepaticæ, professor of botany and director of the Botanical Institute at Graz, died on the 5th of April, in the fifty-third year of his age.

IN THE *Italian Journal of Botany* (April 7) there are described numerous cases of teratology, illustrated with four plates, thus bringing together a large amount of information for those interested in this subject.

A SUPPLEMENTAL list of works on North American fungi, by Dr. Farlow, has been issued as No. 31 of the bibliographical contributions of the library of Harvard University, being a continuation of No. 25.

THE PARTS comprising the Gamopetalæ of Gray's Synoptical Flora have been collected and issued in one volume, as No. xxxi of the Smithsonian Miscellaneous Collections. Corrections have been made, as far as could be done upon the electrotype plates.

DIRECTIONS for preparing twenty-three fungicide solutions or powders are given in a special bulletin of the section of vegetable pathology of the Department of Agriculture. The value of most and the best time and methods for applying them remain to be tested.

THE BULLETIN of the Botanical Department of the State Agricultural College of Iowa for 1888 has been issued. It contains the account of a large amount of work done by Dr. B. D. Halsted and his pupils. Almost every region of botany is touched upon, from bacteria to Iowa weeds.

A NEW Peronospora, P. Lapponica, from Lapland, on Euphrasia officinalis, is described in the last *Botaniska Notiser* (p. 49). It differs from P. densa on the same pest by its larger and colored conidia, and more closely resembles P. sordida. It should be looked for by collectors in America.

THE "Gray Memorial Botanical Chapter" of the Agassiz Association has a good constitution and ought to be a very successful organization. Its members are scattered through several states, the president being G. H. Hicks, of Grayling, Mich., the secretary E. L. Byington, of Colorado Springs, Colorado.

DR. C. WARNSTORF, of Neuruppin, Germany, has begun the issue of a collection of European Sphagnaceæ. The first century contains numerous new forms. The labels bear not only the usual data, but descriptions of the new forms, with critical remarks and drawings of the branch and stem-leaves, sections of the branch-leaves, etc.

DR. JULIUS RÖLL, of Darmstadt, accompanied by Mr. Albert Purpus, has undertaken a collecting tour along the line of the Northern Pacific Railroad. Dr. Röll will give special attention to collecting mosses, and hopes to bring back a valuable collection. Vancouver Island is their first objective point, whence they will gradually work back to St. Paul.

VOL. XIII. NO. 7.—BOTANICAL GAZETTE.—JULY, 1888.

Spore-dissemination of Equisetum.[1]

F. C. NEWCOMBE.

(WITH PLATE IX.)

The subject of spore-dissemination of Equisetum may be considered under three heads:

I. Elongation of the axis of the spike.

II. Structure of the sporangium-wall and its mode of dehiscence.

III. Structure and action of the elaters.

Unless otherwise stated, these notes are wholly on Equisetum arvense preserved in alcohol.

I. *Elongation of the axis of the spike.*—In the immature spike the peltate scales which bear the sporangia on their inner surfaces are closely united edge to edge, forming an unbroken wall; but as the spores are nearing maturity the axis of the spike and the stalks of the peltate scales rapidly elongate, causing each scale to become separated by a considerable space from its neighbors. By careful comparison of cellular structure, this elongation seemed to be due to increase in length of cells. Longitudinal sections from the axis and scale-stalks of several spikes in which the scales were about to separate were made, and similar sections from the corresponding parts of spikes with separated scales. In each comparison the difference in length of cells was easily perceptible, the cells of the fundamental tissue in the different axes giving as the result of many measurements of length the ratio of 3 to 4. Thus, by the separation of the scales, resulting in the drying of sporangium-wall and spores, and furnishing a means of escape for the spores after they have left the sporangium, the first step in spore-dissemination is accomplished.

II. *Structure of the sporangium-wall and its mode of dehiscence.*—Each of the numerous scales of the spike is attached by a stalk running from the center of the scale to the main axis. Around the stalk and attached to the scale are from five to ten sporangia, arranged in a single row. A sporangium is shaped like the finger of a glove. The dehiscence extends the whole length of the sporangium, and is always along the surface which is directed toward the stalk of the scale.

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[1] Contribution from the botanical laboratory of the University of Michigan.

Examined with the microscope, the sporangium-wall is seen to be composed of several layers of cells. The attention is first caught by the appearance of the external layer of cells. These are found to have a definite arrangement, as indicated diagramatically in fig. 1. For convenience the surface of the sporangium which is nearest the stalk may be designated as the inner or ventral, and the opposite one as the outer or dorsal surface. Along the ventral surface are sometimes three, sometimes four, rows of cells, with their long axes at right angles to the long axis of the sporangium. Passing outward on each side from these rows of transverse cells the other cells of the external layer of the wall become more and more oblique, till on the dorsal surface they correspond in direction with the long axis of the sporangium.

In the three or four rows of transverse cells of the sporangium-wall, usually one row is of shorter cells than those composing the other rows, and the cells of this row are strengthened by rings. The transverse cells of the adjoining rows are marked by both rings and spirals; and the oblique and longitudinal cells are spiral, an annular cell being very rarely found among them (fig. 4). In Equisetum hyemale, however, though the transverse cells are mostly marked with rings, the other cells, without definite arrangement, are some annular and some spiral.

In additiön to this outside layer of cells, the sporangium-wall contains two or three other layers of cells, not so conspicuous as the annular and spiral cells just described, but none the less constant. The sporangium-wall has been described by authors as composed of a single layer of cells. In Equisetum arvense and hyemale this is certainly not the case. These inner or lining cells have probably escaped notice because of the difficulty in detecting them by looking down upon or through the sporangium-wall. If sections of the sporangium be examined, the inner layers of cells become clearly visible. In working out this structure, groups of sporangia of Equisetum arvense were carefully imbedded in paraffin, and both longitudinal and transverse sections made on the rocking microtome. On examination, the tissue was found to have been injured in no way by the process of imbedding. Fig. 5 is a portion of a longitudinal section of a sporangium with a part of the peltate scale and of the stalk: *a*, portion of the scale-stalk; *b*, section of the transverse cells of the ventral wall of the sporangium; *c*, section of the dorsal wall of the sporangium; below the sporangium is the scale in which the fibro-vascular bundle is seen to end. The spiral cells of the dorsal surface are continuous with the epidermal cells of the scale. Occasionally a spiral or annular cell is found in this epidermis. Fig. 6 is a transverse section of a sporangium-wall, midway between base and apex. In three positions—one dorsal and the other two lateral—the wall is strengthened not only by an increase in size of the spiral cells, but also by a greater number of the inner or lining cells. As we approach the region of the ventral transverse cells, the sporangium-wall becomes thinner and thinner by the decrease in number and size of the lining cells. Sometimes—as shown in fig. 6 at *a*—the lining cells can be seen to be continued across the external transverse cells; but here the inner cells are always reduced to a single very thin layer. Usually this layer of lining cells disappears in the ventral region; for it becomes closely appressed to the transverse cells. From the base to the apex of the sporangium, the lining cells are never more than one layer thick in the region of dehiscence, while dorsally and laterally these cells are three layers thick at the base and two layers thick at the apex.

Sablou[1] found that the length of the moist spiral cell was to that of the same cell when dry as 20 to 14, while the width is imperceptibly lessened.

In alcoholic material the relative length of the cell when moist and when dry is, with slight variation, as 2 to 1; the relative width, as 4 to 3. From the arrangement of the external cells of the wall, it is evident that the sporangium will contract in length much more along the dorsal than along the ventral surface. In fig. 3 the position of the line of dehiscence in the moist sporangium is indicated by an unbroken line. From what we know concerning the arrangement of the external cells and their contraction, we should expect, in drying, one edge of the wall along the line of dehiscence to move to the position indicated in fig. 3 by a dotted line—this line moving, as it passes from the base, more and more from its original position. And this is exactly what happens, as shown by fig. 2, which gives the appearance of an open sporangium.

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[1] Annales des Science, 7 Series, Tome 2.

The act of dehiscence of the sporangium was observed in six cases. The rupture begins near the apex, a little toward the ventral surface. The opening is at first irregular, with radiating lines extending between surrounding cells; but soon the dehiscence takes a definite direction between two rows of transverse cells—this being the place where the wall is thinnest, and the line between adjacent rows of external cells straightest. The line of dehiscence in its descent to the base frequently passes from one side of a row of transverse cells to the other side. Near the apex especially the dehiscence is usually quite irregular, as shown in fig. 2.

What is the function of the transverse cells? It can not be merely to pull the wall apart; this is accomplished in a greater degree by the oblique and longitudinal cells. The transverse cells prevent the ventral wall of the sporangium from shortening equally with the dorsal wall—thus assisting in dehiscence and causing the edges of the open sporangium to gape widely.

III. *Structure and action of the elaters.*—The external coat of the spore divides at maturity into four narrow, spiral bands—the so-called elaters—as shown in fig. 7. If the spore be allowed to dry, or if it be immersed in glycerine, the elaters will unwind as shown in fig. 8, remaining attached to the spore at one point. If in fig. 7 we call the positions of the expanded ends of the elaters the poles of the spore, then the elaters are attached to the spore at the equator. When the elaters are outstretched they may, as stated by Sachs, assume the form of a cross; but they do not cross one another. Often, in straightening out, the elaters become detached from the spore. If one such detached elater be examined, there will frequently be found, about half-way from end to end, a very thin bit of membrane attached by one edge to the elater (fig. 8). This piece of membrane has the appearance of having been peeled off the surface of the spore.

To account for the hygroscopic movements of the spores, the elaters have been described by Sablou as composed of two layers—an external cellulose layer, and an internal layer of lignine. Two layers may be demonstrated both mechanically and chemically. If pressure be exerted on the cover-glass so as to crush the spores underneath, some of the elaters will be found in the condition shown in fig. 10. Here there is an evident separation between the two layers. If spores be placed in Schultze's solution or in picrocarmine, the two layers of the elater are differently stained. The outer layer is probably cellulose and the inner lignine, as stated by Sablou. In Schultze's solution the outer layer does not seem to give a characteristic cellulose reaction; the inner layer is stained yellowish brown. In iodine solution, with subsequent addition of sulphuric acid, the outer layer of the elater shows, after an hour or two, a decidedly blue color.

Perhaps the most noticeable feature of the minute structure of the elaters is the striation of the cellulose layer, distinguishable without the use of reagents, but made a little more distinct by the application of caustic potash. Everything seems to indicate that the cellulose layer is built up of oblique laminæ, separated by much thinner plates of a substance of different refractive power. If an elater lies in a position vertical to the view, with either its external or lateral surface toward the observer, the direction of the laminæ is from left to right downward (figs. 10–11). That these are really laminæ is proved by their tendency to separate under pressure instead of breaking across (fig. 11). By actual measurement, these laminæ are found to be thinner when dry than when moist. The result of such shrinking is the unwinding of the elaters, provided that the shrinkage is less in the inner layer. A cross-section of an elater gives the form indicated in fig. 12.

Recapitulation: I. The first step in spore-dissemination is the separation of the sporangia-bearing scales by the elongation of the axis of the spike, thus allowing free circulation of air for drying spores and sporangia, and providing open spaces for the escape of the spores after dehiscence of the dry sporangia.

II. The comparatively straight columns or rows of transverse cells in the ventral wall of the sporangium, together with the thinning out of the wall in this region, furnishes a line of weakness which becomes the line of dehiscence. Moreover, the unequal contraction in length and width of the strong external layer of cells of the sporangium-wall results in a great shortening of the dorsal wall and a slight shortening of the ventral wall, thus causing a wide opening in the ruptured sporangium for the passage of the spores.

The hygroscopic properties of the elaters seem to be satisfactorily explained by the difference in chemical composition of the two layers composing them.

The function of the elaters is twofold: (1) to push the spores out of the sporangia; (2) to furnish sails for catching the wind by which the spores are distributed.

Ann Arbor, Mich.

EXPLANATION OF PLATE IX.—Fig. 1. Sporangium of Equisetum arvense, × 80. This figure is diagrammatic; but the cells are represented in true position and size; *a*, probable line of dehiscence; on each side of this line are the transverse cells; at the left are the longitudinal cells of the dorsal wall; and between transverse and longitudinal cells are the oblique cells.

Fig. 2. Sporangium of E. arvense after dehiscence, × 30.

Fig. 3. Diagram of a sporangium of E. arvense, × 30. The unbroken median line shows the position of the line of dehiscence before rupture; the dotted line shows the relative amount of shortening of the dorsal and ventral surfaces of the dry sporangium. The dotted line would also represent one border of the gape into the ruptured sporangium.

Fig. 4. Portion of the wall of E. arvense, to show cells in the region of the line of dehiscence, × 175. Here are three rows of transverse cells containing rings and spirals.

Fig. 5. Longitudinal section of the lower part of a sporangium of E. arvense, with a portion of the scale and scale stalk, × 125: *a*, cells of the scale stalk; *b*, section of the ventral transverse cells of the sporangium-wall; *c*, section of the dorsal wall of the sporangium. Below the cavity of the sporangium is a portion of the peltate scale.

Fig. 6. Transverse section of a sporangium of E. arvense, midway between base and apex, × 125: *a*, probable location of the line of dehiscence.

Fig. 7. Spore of E. arvense, with the elaters beginning to unwind, × 350.

Fig. 8. Same with elaters outstretched, × 350.

Fig. 9. One of the elaters of the same, showing triangular membrane at the place of attachment, × 350.

Fig. 10. Portion of an elater of the same, showing separation of cellulose from the inner layer, × 700.

Fig. 11. Expanded end of an elater of E. arvense, showing a split between the laminæ, × 700.

Fig. 12. Cross-section of an elater of the same, × 700.

Personal reminiscences of Dr. Asa Gray.[1]

C. V. RILEY.

The greatest of America's botanists, Asa Gray, will nevertheless be remembered for many other qualities. He was essentially a self-made man, and rose to preëminence through his own good qualities of heart and head, coupled with enthusiasm and perseverance. There was nothing stilted or self-contained about Gray, no congealing atmosphere surrounding him. He was one of the people, and few men, in dying, have had more sincere mourners.

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[1] Remarks made at the Gray memorial meeting, held by the Biological Society of Washington, April 5, 1888.

Doing an immense deal of what Prof. Lesley has so fitly characterized as "dead work" in science, he yet found time not only to popularize his favorite study, but to deal pointedly with such broad and philosophic questions as grew out of the vast structure of fact which he so zealously helped to build. Where so much pure systematic work was accomplished, and so much more planned, it is no easy matter (as some of us realize but too well) to rise above the vast detail and lay such a broad educational foundation as this master did.

Gray took a medical course, but can not be said to have had a classical education; yet no man wrote more pleasingly or with more grace and accuracy, and we can all indorse Sir Joseph Hooker's words when he says, in a late able notice, that "How Plants Grow" and "How Plants Behave" for charm of matter and style have no equal in botanical literature, and rival chapters in Kirby and Spence's Introduction to Entomology.

It seems almost a work of supererogation to endeavor to convey any personal reminiscences of one who was so familiar a figure to so many of those gathered together here to do honor to his memory. My own personal relations with him can but reflect those of hundreds of Washingtonians. They grew out of the impulse which had been given to the subject of the interrelation between insects and plants some two decades since—an impulse which his own charming writings did so much to quicken. I shall never forget the keen interest and relish he displayed in the first paper read before the American Association for the Advancement of Science at Dubuque in 1872, on the Pollination of Yucca by Pronuba. Those present on that occasion will remember with what joy he hailed such a unique case of direct interdependence between a plant and an animal. I have had the privilege of his hospitality at Cambridge, and have spent some joyful hours with him in travel and in camp; but, whether around his own hospitable table, amid the refinement of his home life, or in the herbarium or the experimental gardens surrounding it; whether amid the whirl of travel, or in the quieter enjoyment of camp life on Veta Pass, I have always experienced exceptional inspiration, delight and instruction in the communion. True to his name in color of cloth and hair, his gray, spare and active form ever conveyed a sense of untiring energy both of mind and body. His unflagging industry and cheeriness, together with an undercurrent of humor—which could no more verge on the gross or profane than the dove could imitate the vulture—made him the life of any party, and I well remember, during the memorable Gray-Hooker excursion in the west, how Sir Joseph and the other English members of the party never ceased to marvel at his unceasing alertness. It was, indeed, difficult to realize Gray's age because of this activity, and at a time in life when men are ordinarily bowed with the weight of years—when the machinery gets out of order and refuses to run smoothly—he could outwalk and outwork most of us. His bright intelligence, genial disposition and charming personality, which, as Hooker remarks, gave him the entré to *salons* as well as to the museums of every capital, upon his first visit to Europe, just half a century since, continued through the mellowing influences of age.

One day last October I was dining with a friend in the magnificent new building on the bank of the Thames of the National Liberal Club of Great Britain. The conversation naturally turned on Gladstone: "How does he act and appear," I asked, "when he is among you at the club?" "Oh," my friend replied, "he so entirely throws off his age in animation that he would be one of the youngest of us if we gave him a chance to be; but he sheds such an atmosphere on the few occasions when he visits us, and the members crowd around him so eager to hear his voice and to pay him homage, that he never gets the chance."

Gray had something of this same magnetism, and similarly influenced the younger generation of naturalists on all public occasions. In all my personal recollections of Gray, however, he is indelibly associated with one who must have wielded a most beneficent influence over him. I can not think of them apart. She, his boon companion, with whom we so sincerely condole in her widowed bereavement, was always and everywhere by him. I do not know how much or how little she quietly helped him in his botanical work; but I know that no wife was ever more sympathetic with her husband's efforts, more tender, true and solicitous, than the sweet-faced, lovable and loving woman who is so essentially linked with our recollections of the man. The implicit trust and confidence with which he would appeal to her on all occasions, and the manner in which toward the end he would depend on her quicker ear and keener eye, were beautiful to behold.

Few men have taken more active part in the discussions of the day, or acted more constantly or prominently as critic and reviewer. Yet, while he could be severe in private, his public censure or blame was tempered not only by consideration, but by the conspicuous justness and soberness of his views. So it came about that he retained the esteem of those he most often condemned. One striking illustration of this trait, within my knowledge, may be referred to. Few men were more often reproved by him than a whole-souled friend of mine who has done much for horticulture and botany, but has, withal (as who of us has not?), sometimes been wrong both in observation and conclusion. Shortly after Darwin's death, a leading natural history magazine published an extremely unjust and personal paragraph about the gentleman referred to, pretending to quote Darwin's opinion. Though he had done much to promote the monthly referred to, Gray was thoroughly incensed at the spirit of the paragraph, and never afterward had the old sympathy with the magazine.

Transcending almost in importance even the influence of his botanical and intellectual work proper, I hold to be the value of the lesson of his simple, stainless life. Hooker points out the great similarity in the lives of Gray and the elder De Candolle. In the purity of his character, in the affability of his manner, in the breadth of his mind, and the democratic approachability of the man, if I may so express it, I can not help coupling his, in thought, with that other great mind which but lately ceased to work, and but lately we met to honor. Spencer F. Baird and Asa Gray had much in common besides the influence which both exerted on natural science.

Gray's private correspondence must have been immense. His hand-writing was rather on the sprawly order, indicative of hurry and pressure, and in this, together with the tendency to abbreviate and the frequent omission or malformation of a letter, recalls that of the illustrious Darwin. The style of his correspondence was pointed, clear and happy, and often spiced with bits of humor—in short, like the man.

The last time I met Dr. Gray was in September of last year during the meeting of the British Association for the Advancement of Science, at Manchester. He had been in Europe for some time, and, as on previous visits, had been everywhere honored, and those Americans in attendance were glad to find him very much the same active, cheerful spirit as of old. Yet in conversation and upon closer contact a diminution of vigor, a diminished brightness of the eye, and a greater tendency to lean on Mrs. Gray, were noticeable. He was naturally more often in section D (biology) than in the other sections, and frequently on the platform. The reading of the annual address by Prof. Alfred Newton, the president of the section, was an occasion of exceptional interest. Seated upon the platform were many eminent biologists from all countries, but the mention of the name of none of them called forth such universal marks of sympathy and applause as that of our beloved Gray. The occasion was inspiring to an evolutionist because President Newton devoted a large portion of his address to the then unpublished "Life and Letters" of Darwin, the proofs of which he had been allowed to see in advance. Tenderly and sympathetically he dwelt on the charm and the noble character of the man, aside from his work, showing clearly that,

"Whatever record leap to light,
He never shall be shamed."

He laid emphasis on the fact that in that year of British jubilee there was a fitness in the theme, because it was exactly the fiftieth anniversary of Darwin's first conception of his main theory, as shown by an entry in his pocket-book for the year 1837. He alluded most touchingly and feelingly to Gray's part in helping to diffuse and promulgate Darwinism, as clearly brought out in the "Life and Letters," and particularly to the early correspondence with Gray, and the letter of September, 1857, in which was clearly sketched the general outline of the theory of natural selection, and which was so important in establishing the relative claims to priority of discovery of Darwin and Wallace. The very marked and fervid expression of admiration manifested by the audience as Prof. Newton, in this part of his address, faced Dr. Gray, was certainly most gratifying to every American present; and when at the close of the address there was a spontaneous call for the eminent botanist, words can not depict either the emotion of Gray himself or of the audience, as it breathlessly listened to his few words. His voice was weaker than I had ever known it, and so low, indeed, as to be at times unheard in the rear of the hall. In supplementing Newton's feeling contribution to the memory of Darwin, he spoke of natural selection as a thing so self-evident that it no longer needed argument; that, at the same time, it had little to do with the cause or causes of variation. He intimated that botanists were formulating some new conceptions, but did not indicate what these might be.

Now, I have no idea that Prof. Ward will have left anything unsaid in reference to Gray and Darwinism, for no one is more competent to handle the subject fully and thoroughly; and if I venture, in closing, on a few thoughts which naturally grow out of this my last meeting with Dr. Gray, it is with a feeling that perhaps my able predecessor may not do full justice to the design side of the question.

The opening of our civil war witnessed the beginning of a discussion which, in its effects on the thought and civilization of the future, will be as far-reaching as the contest which eventually led to the abolition of slavery in our land. From the time of the appearance of the "Origin of Species" Gray fought for and Agassiz against the theory of natural selection and of the derivation of species from pre-existing species. The cause of freedom has not more completely conquered in the intervening time than has the cause of evolution. The names of Gray and Agassiz will ever stand in our history as typical of the opposing ideas on this question, as those of Grant and Davis will of the ideas that divided the North and South. What more striking illustration of the completeness of the revolution than that Gray should have succeeded to the place of Agassiz as one of the regents of the Smithsonian Institution!

Gray was almost alone at first in meeting the skepticism and opposition to Darwinism in this country, and no one who is not familiar with his writings can form an idea of the great service he rendered to sound science and true religion by the clear and conservative nature of his advocacy. Yet throughout the long-continued and good-natured correspondence between Gray and Darwin one most marked difference is observable between the two men. Darwin, in the beginning, was more of a theist than at the close of his life, and his work in evolution may be said to have rendered his views more and more materialistic. Gray, on the other hand, always believed that variation in its grander movements, if not in its details, was guided by some power to an ordered and definite result. He was, in fact, one of the greatest advocates of design, and saw in evolution only greater reason for believing in an intelligent cause. To use his own oft-quoted words, he was "scientifically, and in his own fashion, a Darwinian; philosophically a convinced theist, and religiously an acceptor of the creed commonly known as the Nicene as the exponent of the Christian faith." Every one in my hearing will understand how this expression of faith is perfectly consistent with firm belief in Darwinism and evolution. Yet the manner in which it can be contorted to suit bias in the opposite direction is very well illustrated by the fact that in a recent necrological notice the editor of a French Canadian magazine asserts that Gray never accepted Darwinism and effectively opposed it.

Some of us are so constituted, mentally, that we with difficulty realize in what we see most manifest in the world—in the misery, suffering and misfortune of individuals—with Pope, that

> **"All nature is but art unknown to thee;**
> **All chance, direction, which thou canst not see;**
> **All discord, harmony not understood;**
> **All partial evil, universal good!"**

Darwin's nose, as he tells us, very nearly lost him the chance of a voyage around the world on H. M. S. Beagle, and in discussing the question of design he asked Sir Charles Lyell whether the latter believed that the shape of his (Darwin's) nose had been designed. We may well ask whether there is any heart behind this whirling matter in which brute force seems to prevail. Yet Gray so ably expounded evolutionary teleology that his writings will win over many converts to his views. The inherent unity in nature is manifest; all life seems to be held in one great bond, and the idea of God is strengthened rather than imperiled, because we have a satisfactory conception of His mode of working. The intellect demands truth, but the heart cries for love. Science may proclaim that "God is truth," but religion ever answers "God is love." The mystery of life—of causation—is as great as ever, and none the less hidden because of what little light is shed for us upon the covering. We are profoundly in the dark regarding some of its simplest ways and manifestations. There are few of us who have not been at times weighed down and awed with the sense of an undefined and indefinable presence in nature, and whether we conceive the creative spirit as an all-pervading, interpenetrating presence ever with us and ever at work in His own way, or as some grand controlling engineer who has in the past created and ordained that all things shall work to an ultimate end, there is something alluring in the idea of design, and, as an article of faith, something sublime.

In contemplating these questions I confess to have been profoundly influenced by Gray's writings, but also to having felt the want of a medium whereby design may be conceived to have operated in the past and may yet be seen to operate. The medium must necessarily be psychic, and, while admitting all logical causes which have been brought forward by evolutionists to explain variation, and fully realizing that natural selection only takes advantage of such variation, I yet believe that there is one influence at work—none the less potent because so subtle, and none the less real because so generally denied—which gives us a tangible theory of design. I allude to the mental impressions—the power of the emotions—of the pregnant mother on her offspring, in inducing either direct modification both psychic and physical, or the tendency thereto, especially under stress or where the necessity to conform to new conditions or environment is great, and the requirements and, as a consequence, the emotions are correspondingly great and exceptional. As a cause of variation this was rejected by Darwin, and the influence is usually denied by medical men on physiological grounds; but we are yet profoundly ignorant of some of the most important functions of both mind and body, and if the fact of such influence can once be established, its bearing on evolution as a prime cause, through impulses from within, of modification that may be guided and directed by an all-pervading mind must be admitted, especially among higher organisms where mind is most developed. Who can safely assert that the fact of such influence is not or will not be established? I have for some time been collecting authoritative data on the subject, and firmly believe, from the evidence, in the power of mind in inducing material modification under the circumstances indicated, and I allude to the matter in this connection because I had occasion to suggest it to Dr. Gray, at Manchester, as a working hypothesis to explain the method of design as affecting animals, and because I was pleased to find him by no means unfavorably inclined to the idea.

Beyond the wonted limit of man's age
He lived, a type of usefulness and peace;
His value growing, with his years increase,
To shed a lustre on our history's page.
Honor was his, and worth excelled by none;
And tempered seemed his being and his powers
By all the sweetness of his loved flowers,

And hers who, for so long, beside him shone,
True-hearted, and may fitly share the wreath
Of fame that crowns him. Health, achievement, love:
These blessed his life, and on his soul serene
(As vouching their continuance after death)
Forever rested, like a brooding dove,
The promise of the gentle Nazarene!

Washington, D. C.

Notes on North American willows. II.

M. S. BEBB.

(WITH PLATE X.)

Salix phylicoides And.—A willow, known of late years as by no means rare in Alaska and on the adjacent shores of Eastern Siberia, was first described by Andersson in his preliminary Synopsis of North American Willows, under the above name, given in allusion to the manifest resemblance which the species bears to S. phylicifolia. Subsequently, the same author divided Seeman's specimens, upon which exclusively the species was founded, making of all those which exhibited normally developed aments a second new species, S. fulcrata, and retaining the original name, S. phylicoides, for a single gathering of a bare half-dozen specimens, all told, made by Seeman at "Awatschka Bay, August, 1848." These, evidently taken from the same plant, present the anomaly, very noticeable in an arctic willow, of aments accompanying full-grown leaves. Prof. Andersson did not overlook the abnormal character of this retarded inflorescence, and it is, therefore, all the more surprising that he failed to appreciate the significance of the fact that most of the capsules are empty and that the few which do contain a little pappus produce no seeds. The diminutive size, to which an exaggerated importance is given in the description, is simply due to non-fertilization! If proof were needed of this I might cite a specimen in the Gray herbarium which, along with the "rectangularly veined" lanceolate-acuminate leaves of the Prodromus S. phylicoides, bears one imperfectly fertilized ament, capsules as in Seeman's Awatschka Bay plant and another fully fertilized ament with capsules 2-3 lines long—leaves and fruit of S. phylicoides, and on the same twig an ament of S. fulcrata!

The species varies much in stature and habit. On the southern shores of Alaska it is apparently a stout bush with erect branches from a decumbent trunk. On the northern shore—Point Barrow, etc.—it is a small prostrate shrub, spreading over two or three feet, but keeping close to the surface of the ground. The leaves vary in outline from lanceolate to elliptic, entire or obscurely serrulate, the aments from oblong to narrowly cylindrical with or without bracts, no one of these characters being constantly associated with any peculiar veining of the leaves.

The long linear-lanceolate stipules constitute a distinguishing feature, and, clinging to the stems as they do for two or three years, often render possible the identification of staminate aments unaccompanied by leaves.

Without understanding the shifting about which Seeman's specimens received in Andersson's hands, the student is likely to be mystified by the inconsistencies of the three consecutive descriptions given. For instance, we have, first, in the Salices Boreali-Americanæ "capsulæ 2-3 lineas longæ;" next in the Monographia Salicum "capsulæ lineam longæ;" and finally in De Candolle's Prodromus "capsulæ semi-lineam longæ." From three lines to half a line and not a word to indicate that the phylicoides of the final description is other than the phylicoides of the first! Nay, in the final description reference is directly made to the original publication in the Sal. Bor.-Amer., while on the opposite page under S. fulcrata we read: "*Huc forsam etiam pertinet S. phylicoides, Anders. Sal. Bor.-Amer.*" Happily, we now know, if Prof. Andersson did not, that all this confusion falls within the limits of a single species for which S. phylicoides is the oldest name; happily, too, the original description recognizes only the normal character of the species and altogether ignores the imperfect development exhibited by a few chance specimens.

Rockford, Ill.

Explanation of Plate X.—Figs. 1-7. Seeman's plant, "N. W. America," type of S. phylicoides and afterwards of S. fulcrata, from fragments given me by Sir Joseph D. Hooker, accompanied by tracings and sketches by Prof. Oliver; 1, 2, leaves; 3, capsules ×6; 4, ament; 5, stipule ×3; 6, scale ×6; 7, emarginate stigmas ×6.

Figs. 8–10. Plant coll. McKay, Nushajak, Alaska; 8, leaves; 9, lower portion of a large ament to show the leafy peduncle; 10, 11, capsules of S. phylicoides And. DC. Prod., abortive, from Seeman's Awatschka Bay plant!

Figs. 12–15. Coll. Harrington, Nagai Island, Shumagins (Herb. Gray); 12, leaf showing "rectangular veining;" 13, capsule normally developed ×6; 14, capsule from the same plant, abortive (like the Prodromus S. phylicoides ×6); 15, stipule ×3.

Undescribed plants from Guatemala. IV.

JOHN DONNELL SMITH.

(WITH PLATE XI.)

Gonzalea thyrsoidea.—Pilose: leaves except veins glabrate, oblong (8-9 inches), each end acuminate, shortly petioled: thyrsus virgate, a foot long; flowers 3-7, pedicellate, in scattered nearly sessile cymose clusters: calyx-tube produced; teeth smooth, colored, small, triangular, unequal: corolla-tube cylindrical, 7 lines long; lobes nearly half as long, of a darker red, farinaceous and arachnoid within, their contact in æstivation alternately imbricate and induplicate-valvate: anthers barely included: style scarcely attaining to their base; divisions of stigma 4, linear: disk radiately 8-lobuled: ovary 4-locular.—Mountains of Pansamalá, Dept. Alta Verapaz, alt. 3,800 feet, May, 1887. (Ex Plantis Guatemalensibus Tuerckheimianis, quas edidit John Donnell Smith, 1249.)

Mikania pyramidata.—High-climbing shrub with ferruginous-hirsute branches, petioles and inflorescence: leaves pubescent, more scabrid above, ovate-lanceolate, slenderly acuminate, 4-8 inches long, base truncate or rounded, margin with an angulate tooth and distant callose points, nerves from base in 2-3 remote pairs: panicles pyramidal, compound, densely flowered, 6-12 inches long; branches brachiate, leafy-bracted below, the upper alternate; heads loosely corymbose, pedicels equaling involucre; its bracts glabrate, linear-oblong (2 lines), apex obtusish and pubescent, subtending bract shorter and lanceolate or none: corolla equaling involucre; limb campanulate, exceeding slender tube, cleft to middle in ovate-lanceolate lobes: akenes nearly smooth, a little exceeded by involucre and sordid-white pappus.—Forest near Coban, Dept. Alta Verapaz, alt. 4,300 feet. January, 1887. (Ex Pl. cit. 1106.)

Zexmenia Guatemalensis.—Fruticose, scabrid, cano-pilose: leaves muricate-scabrous above, hairy beneath, tripli-nerved, mucronately denticulate, ovate-lanceolate, 4-6 inches long, spatulately narrowed to dilated connate base: peduncles cano-lanate, 3-5, subumbellate at apex of branches, exceeded by subtending leaves: heads hemispherical, 5 lines high; exterior bracts of biserial involucre 5, herbaceous, a third longer than the 8 inferior: rays 8, bidentate, 6 lines long:

disk-corollas a little exceeding involucre, equaling produced rigid tips of lacerate chaff, limb exceeding tube, lobes cano-hirsute: ray-akenes obovate; pappus-teeth confluent with wings, incurved-lanceolate, shortly-awned, connate, the lateral equaling corolla-tube: disk-akenes oblong-turbinate, subtriquetrous, costate, puncteolate; pappus a squamellate cup, exaristate or occasionally 1-awned.—Coban, alt. 4,300 feet, February, 1886. (Ex Pl. cit. 853.)

Encelia pleistocephala.—Branches angulate, purplish, pubescent toward inflorescence: leaves alternate, scabrid above, pubescent beneath, penninerved, callose-denticulate, oblong-lanceolate, 5-6 inches long, acuminately narrowing to a channeled petiole an inch long: corymbs compound, dense, a little surpassing leaves; heads long-pedicellate, 6 lines high; involucre half as long, campanulate, purplish-green, pubescent, 2-3-serial, inner bracts oblong, outer smaller and thick: rays 5-6, oval, 2 lines long, 3-denticulate, yellow, tube equaling involucre; disk-corollas equaling rays, exceeding concave pubescent chaff, lobes darker yellow: anthers black, barely exserted: akenes spatulate, nerved, nearly smooth, margins ciliolate; awns from inner side of conspicuous teeth, upwardly barbellate, equaling corolla: abortive akenes occasionally triquetrous, unequally 2-3-aristate.—The anomalous inflorescence recalls several *Verbesinæ;* but technically distinct by neutral rays.—Rocks near Coban, alt. 4,300 feet, February, 1887. (Ex Pl. cit. 1121.)

Gonolobus velutinus Schlecht., var. **calycinus.** — Indument pilose, uniform throughout of young leaves and follicles dense: leaves caudate-acuminate, hairs of upper surface from muriculate points: calyx-lobes nearly equaling corolla, roundish with caudiculate barbate apex, otherwise nearly smooth.—In 2458 *Bourgeau*, cited by Hemsl., *Biol. Centr. Am.*, leaves are as in description velutinous, calyx-lobes smaller and not produced.—Pansamalá forest, alt. 4,000 feet, April, 1887. (Ex Pl. cit. 1124.)

Lamourouxia integerrima (§ *Hemispadon* Benth.).—Leaves entire, lanceolate, 16-20 lines long, a fourth as broad: flowers somewhat crowded toward summit of branches: calyx faintly 8-nerved; tube 2 lines long, equaling peduncle, exceeding triangular erect bilabiately unequal teeth: corolla ventricose, 15-17 lines long, 4-5 lines wide at throat, cleft less than half way; posterior lip retuse, rectangular: anantherous stamens half as long as the fertile.—The nearly related *L. lanceolata* Benth., also collected by Mr. von Türckheim, similar in habit, differs by slender serrate leaves, more scattered longer-peduncled flowers, 12-costate calyx with long-spreading nearly equal marginate lobes, straight narrow more deeply cleft corolla, its posterior lip entire with produced angles, longer sterile stamens.—Pansamalá, alt. 4,000 feet, January, 1887. (Ex Pl. cit. 1112.)

Pitcairnia Tuerckheimii (§ *Eupitcairnia* Baker).—Acaulescent: basal bracts lanceolate, attenuately prolonged, retrorsely prickly, 12-18 lines long, passing into similar unarmed basal leaves; those of peduncle cano-floccose beneath, linear-attenuate, erect, the lower 6-8 inches long by 4-5 lines broad: peduncle a foot or more long, like triangular rhachis araneose; raceme 8-14-flowered, internodes of about an inch; bracts ovate-lanceolate to ovate, 7-4 lines long, equaling smooth erecto-patent pedicels: sepals like bracts uncolored, glabrous, linear-tapering, acute, 12-14 lines long, scarcely 1½ lines broad: petals nearly 3 inches long, crimson, paler below, basal scales absent: anthers protruding: style exceeding petals.—Rock-crevices, Santa Rosa, Dept. Baja Verapaz, alt. 5,000 feet, July, 1887. (Ex Pl. cit. 1298.)

Nephrodium Tuerckheimii. Bot. Gazette, xii, 133.—Explanation of Plate XI: Fig. 1. Frond reduced. Fig. 2. Portion of base of frond: nat. size. Fig. 3. Rootstock: nat. size. Fig. 4. Base of a lower pinna: nat. size. Fig. 5. Two segments of a pinna: enlarged. Fig. 6. Portion of a segment: more enlarged. Fig. 7. Indusium: magnified. Fig. 8. Scale from stipe: magnified.

An apparently undescribed species from Costa Rica is here added. It is numbered 176 of a small collection made by Señ. Juan J. Cooper, near Cartago, alt. 4,500 feet, December, 1887.

Zanthoxylum Costaricense.—Branches flexuose, armed with compressed recurved spines, glabrous, blotched with black exudations: petioles canaliculate, 6-9 lines long; leaflets 3, terminal exceeding others, oblong (21-26 lines), apex acuminate and retuse, base acute, crenulate, punctate throughout: panicles axillary and terminal, scaly-bracteoled, verrucose; in fruit ramified, an inch or more long, from leafless nodes: flowers not seen: cocules 1-2, globose, glandular-tuberculate, dehiscing to base, stipe and gynophore each about half a line long: seed globose.—A shrub 10-15 feet high, known as "Limoncillo."

Baltimore, Md.

BRIEFER ARTICLES.

The subterranean shoots of Oxalis violacea (WITH PLATE XII).—Though one of the commonest plants in the prairie states the violet wood-sorrel is usually gathered so early in the season that several interesting features are not commonly represented in herbaria. While enjoying a few days in looking at the rich flora about Mount Carmel, Ill., in company with Dr. Schneck, a fortnight since, I succeeded for the first time in getting specimens of this species, with the subterranean bulbiferous shoots that are characteristic of the section to which it belongs; and the subsequent collection of a fine lot of plants in the same condition near St. Louis by Mr. Pammel enables me to figure the plant for the GAZETTE.

In the specimens collected the watery tap-root, which is represented in occasional herbarium specimens, but is not very often collected, although it is a normal part of the plant from this time on, was finely developed, in some instances reaching a length of two inches and a diameter of over half an inch. From the withered bulb just above this protruded three to nine fleshy white runners one or two millimeters in diameter, and in some cases considerably over two inches long, remotely scaly below, the rather acute apex somewhat enlarged, and with crowded scales, the inner very thick and yellow, forming the young bulb of next season. The runners appear to curve downward at first, afterward bending upward at the apex.

References to the literature of the subject, especially with respect to other species, are given in my biological notes on the genus (*Memoirs Boston Soc. Nat. Hist.* iv, 92). WILLIAM TRELEASE, *St. Louis, Mo.*

EXPLANATION OF PLATE XII.—*Oxalis Violacea* L. 1. Short-styled plant, showing the watery tap root and bulbiferous shoots, natural size. 2. Longitudinal section through the end of a runner, × 10. 3. Seed, × 30.

Diervilla rivularis, n. sp.—Shrub two to five feet high; whole plant hirsutely pubescent: branchlets nearly terete: leaves subsessile, ovate or oblong-lanceolate, acuminate, unequally and obtusely serrulate, pale beneath: flowers lemon yellow, larger than those of D. sessilifolia, in three to six or more axillary cymes, these often floriferous: calyx-lobes lanceolate-subulate, about as long as the attenuate neck of the carpel: corolla slightly bilabiate.—First collected in flower July 6, 1880, on the banks of "Lula Falls," Lookout Mountain, a few miles across the Tennessee line in Georgia. It grows close to the water's edge. I have received this spring from Kelsey brothers, Highlands, N. C., the genuine *D. sessilifolia* Buckl., which now flowers in my garden; but it is glabrous throughout, with smaller, more regular flowers, which are sulphur or greenish yellow. D. rivularis is a handsomer plant.—A. GATTINGER, M. D., *Nashville, Tenn.*

EDITORIAL.

THERE ARE many botanists who are in no position to do conspicuous work, and it is perhaps fortunate for botany that this is true. It is certain, at least, that the opportunity of doing good work in a very conspicuous way does not always reflect great credit upon the worker. At the same time, these botanists are desirous of doing some sort of work, and of not doing it at random. There is work and work in botany, and much of it is like moving a pile of bricks back and forth from one side of a field to the other; it may be good exercise, but a dreadfully uninspiring result. It is like teaching a class to do nothing but name plants, which one of our bright botanists says is like chasing a woodchuck into a hole—one has nothing to show for it but the hole. All botanical work should mean something; should be some little contribution toward a better knowledge of botany. There is a very hopeful field of work that can be cultivated by these isolated botanists who are desirous of doing something of value, especially hopeful because it is so exhaustless. Systematic botany will never reach its highest expression until there is complete knowledge of the minute as well as the gross anatomy of all groups of plants. So little is our knowledge, comparatively speaking, of this extensive field, that no generalizations can yet be attempted, and every good worker with a microscope can easily become a contributor. The work will have to be done in this piecemeal way by very many investigators, and no one need fear that this sort of work will soon "run out." Two closely allied groups of plants would form a fine subject for any one's investigation as to their comparative anatomy. It is hardly necessary to say that we do not refer to the casual comparison of a few sections, but to that patient, laborious, "over-and-over" study of every tissue which alone will bring permanent results. This is suggested as one field of work among many, especially convenient to those who are fond of using the microscope, and possibly useful in saving them from that aimless frittering away of strength which is too apt to be the fate of the owner of a microscope.

OPEN LETTERS.

Michigan Forestry Commission.

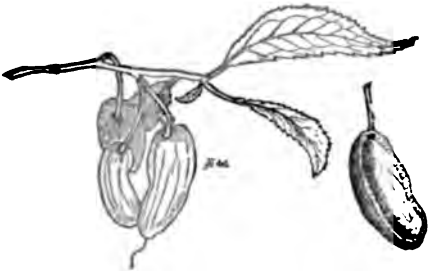
Michigan has long been prominent for the large amount of its timber. The rapid disappearance of this by cutting and fires has caused some to begin to study the subject with reference to legislation. Instead of enacting laws hastily last winter, the Legislature made the State Board of Agriculture a forestry commission, with $1,000 at their disposal. Hon. C. W. Garfield and the writer are the directors of this commission. We are to make investigations and report to the Governor, with recommendations as to any needed legislation. In studying the subject it is thought very desirable to select three to six townships of land, which shall be held as a forest reserve. Here nature should take possession; the woody plants and herbs and the harmless game should be protected.

In the recently established experiment station of the Agricultural College some attention is to be given to the "jack-pine" lands, or pine plains, where Pinus Banksiana is the leading tree. The authorities have stations already started in five counties, viz.: Lake, Clare, Iasco, Crawford and Grand Traverse. Here the pine plains land is to be tested with grasses, other forage plants and forest trees. W. J. Beal.

Agricultural College, Mich.

Diseased plums.

The accompanying drawing (half natural size) represents an abnormal growth of the plum (Prunus Americana), produced in consequence of the attack of a fungus. The ovary has been swollen into an inflated sac, with thick and spongy walls, and occasionally contains an elongated body, apparently the aborted ovule. The fungus causing the abnormality is known as Ascomyces Pruni, or Exoascus Pruni, or Taphrina Pruni. The reproductive bodies appear as a white powdery substance on the outside of the swollen sac. Has this species been recorded in this country before now?



Oxford, Ohio. Joseph F. James.

Proterogynous Umbelliferæ.

In the May number of the Gazette, p. 134, Prof. Trelease has again started the question of proterogyny in Umbelliferæ.

In 1887 I made a special study of the floral characters and insect visitors of most of the species growing in my neighborhood, and I may give the general result of my observations, although I must refer the reader to a forthcoming paper for my mature views and for the details on which those views rest.

In my opinion Hydrocotyle umbellata (observed at Orlando, Fla.), Eulophus Americanus, Cicuta maculata, Sium cicutæfolium, Osmorhiza longistylis, Pastinaca sativa and Heracleum lanatum are proterandrous.

Sanicula Canadensis, Cryptotænia Canadensis and Chærophyllum procumbeus are synacmic.

Sanicula Marylandica, Erigenia bulbosa, Zizia aurea, Pimpinella integerrima and Polytænia Nuttallii are proterogynous.

Carlinville, Ill. Charles Robertson.

CURRENT LITERATURE.

The Entomophthoreæ of the U. S.[1]

Mr. Thaxter has undertaken a study of the entomogenous plants of North America, and presents his first contribution to the subject upon the group named in the title. The paper embodies not only his own observations, but those of American and European botanists. Of the former just three are cited, as against twenty of the latter. After preliminary remarks upon the sources of material and information, and the four other groups of entomogenous plants, the author proceeds to a consideration of the Entomophthoreæ, of which three genera are found in this country—Empusa, Massospora and Basidiobolus. Entomophthora and Triplosporium are considered as sub-genera of Empusa. The morphology and life history of Empusa are thoroughly treated; the various species are described, and figured on exquisite lithograph plates. Twenty-six species are recognized, of which the following sixteen are new: E. apiculata, papillata, Caroliniana, lageniformis, Lampyridarum, geometralis, occidentalis, dipterigena, virescens, Americana, montana, echinospora, sepulchralis, variabilis, rhizospora and gracilis. Arthur's Entomophthora Phytonomi (BOT. GAZ., xi, 14) is referred to Empusa sphærosperma, and Bessey's Entom. Calopteni (*Am. Nat.*, xvii, 1280) to Empusa Grylli. The monograph is excellently done, and is worthy of the dress and company in which it appears. Botanists can help Mr. Thaxter by sending material to him at New Haven, Conn.

Contributions to American botany.[2]

Dr. Watson finds that our 33 North American species of Vesicaria are entitled to generic rank, and so he cuts a Gordian knot of difficulties by separating them from the Old World forms under the generic name *Lesquerella*. In this way, Alyssum Lescurii of Gray's Manual becomes Lesquerella Lescurii, which double honor is none too much for the veteran Lesquereux to carry. Vesicaria Shortii of the Manual becomes L. globosa. But most of our Lesquerellas are western and southwestern, and the specific names under Vesicaria are, for the most part, transferred to the new genus.

A revision of Draba is also given, showing 32 species, the only change among the eastern forms being the reduction of D. arabisans to a variety of D. incana.

In addition to these revisions, 27 species new to the United States are described, among which is a new genus of Compositæ (Eupatoriaceæ) from Florida, and described by Dr. Gray under the name ***Hartwrightia***.

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[1] THAXTER, ROLAND.—The Entomophthoreæ of the United States. Memoir of the Boston Society of Natural History, Vol. iv, No. vi, pp. 131-201, pl. xiv-xxi, 4to. Boston: Published by the Society, April, 1888.

[2] WATSON, SERENO.—Contributions to American Botany, XV. From the Proc. Am. Acad. xxiii, pp. 249-287. [Issued May 29, 1888.]

Among other interesting new plants are an Ivesia and a Pyrus from the Pacific coast, and a new Tillandsia from Florida.

The second section of the contribution contains descriptions of new species of Mexican plants, chiefly of Pringle's collection in the mountains of Chihuahua in 1887. There are 55 species described, and among them a new genus of Umbelliferæ, *Prionosciadium*, starts out with three species, one of them being the Angelica Mexicana of Pringle's distribution.

The contribution closes with descriptions of eight new plants of Guatemala, one of which is the type of a new genus of Acanthaceæ, *Louteridium* by name.

NOTES AND NEWS.

REV. THOMAS MORONG sailed for Buenos Ayres about the middle of July.

PROF. DUDLEY, of Cornell University, returns from his year abroad about the first of October.

MR. J. N. ROSE, of Wabash College, has been appointed one of Dr. Vasey's assistants at the Department of Agriculture.

MR. F. V. COVILLE, of Cornell University, has been appointed one of Dr. Vasey's assistants at the Department of Agriculture.

DR. DOUGLASS H. CAMPBELL and Dr. Winthrop E. Stone return from Germany in August with the honors of recent doctorates.

DR. W. TRELEASE is spending two months or so at the laboratory of Dr. Koch, in Berlin, carrying on special bacteriological studies.

MR. ERWIN F. SMITH will continue his investigations of "peach yellows" this summer in the orchards of Maryland and Delaware.

PROF. SUSAN M. HALLOWELL, of Wellesley College, having completed her studies in foreign laboratories, returns to America shortly.

ON ACCOUNT of the change to an earlier date for the meeting of the A. A. A. S., Prof. Arthur will not return from Europe in time to attend, but expects to be back by the first of September.

THE SUMMER SCHOOL at Cambridge this year is largely attended. With such a lecturer as Dr. Goodale, and such apparatus as is to be had at Harvard, all surrounded by the botanic garden, it is a wonder that the summer school is not overcrowded.

REV. DR. W. H. DALLINGER has resigned the principalship of Wesley College, at Sheffield, England, and will remove to London, where he intends to fit up a private laboratory and pursue his bacteriological and other studies free from interruption.

AN APPRECIATIVE SKETCH (with portrait) of Dr. Asa Gray, by James Britten, appears in the *Journal of Botany* (June). The portrait does him scant justice, and it is a fortunate thing that most foreign botanists do not have to depend upon it for their knowledge of his personal appearance.

ALTHOUGH several of our botanists are in Europe this summer, there are enough at home to make the Cleveland meeting a great success. The date of meeting has been fixed a week earlier, being August 15. Botanists should all arrange to attend, as personal acquaintance with their fellows is of incalculable benefit.

THE ELECTION of Dr. Sidney H. Vines, F. R. S., Lecturer in Botany at Cambridge, to succeed Prof. Balfour at Oxford, gives general satisfaction in English botanical circles, and not only secures an important acquisition to Oxford, but is a high compliment to Dr. Vines, who was without a competitor for the position.

THE ORIGIN of the tubercles on leguminous roots has given rise to much discussion, the opinion varying between their being normal structures or diseased structures. Dr. Farlow gives a short *resumé* of the subject in *Garden and Forest* (May 16), calling attention to the difficulty of the subject, and also stating that it can be safely said that they are not normal structures.

THE BLACK SPOT, a disease of roses, is treated in the *American Florist* for May 1 by W. S. Windle, a senior student of Purdue University. He describes and illustrates the fungus, Actinonema Rosæ, which causes the disease, and points out that the discoloration of the leaf is due to the gradual filling up of the outer epidermal cells with a dark mass, deposited as a result of the presence of the fungus.

THE BOTANISTS will be well cared for at Cleveland. The Hollenden will be the headquarters of the Botanical Club. Meetings will be held each morning at 9 o'clock. Excursions will be made Friday afternoon and Saturday, and everything that President Day or Secretary Spalding can secure for their pleasure and profit may be expected. There should be a liberal response in attendance and notes.

ALGÆ living upon animals as parasites is a curious subject lately investigated by Mme. A. Weber van Bosse. Several species are described belonging to the genera Trichophilus and Cyanoderma, which infest the hairs of sloths. The damp, shady, tropical forests which form the home of these sluggish animals seems to be sufficient explanation, as pointed out by Dr. Farlow in *Garden and Forest* (April 25).

MIMICRY among plants was recently discussed by Dr. J. T. Rothrock before the Philadelphia Academy. He arranges mimicry under two heads: (1) that found between plants of distinct groups; (2) that found between plants of the same family. In the former case the lower type may be considered an anticipatory or prophetic type; in the latter it seems to indicate a common descent within a recent period.

PROF. L. H. BAILEY, JR., will go abroad in August. He will visit the leading experiment stations and horticultural establishments, and also spend considerable time in studying the originals of cultivated plants at the great herbaria of Kew and on the continent. The Carices will incidentally come in for some share of attention, and much valuable information is likely to be gathered for the better elucidation of our flora.

PFITZER recommends[1] a modification of the soap-imbedding process for a study of developmental processes. A mixture of equal parts of glycerine and 96 per cent. alcohol is saturated at 60°-70° C. with finely shaved, transparent glycerine-soap. The plant parts taken from strong alcohol are brought into the mixture before it sets by cooling. Or they can be penetrated by allowing them to lie in a similar cold-saturated solution of soap. This imbedding mass keeps without change in corked vessels and becomes fluid at 40° C. The action of the alkali of the soap renders the sections particularly clear.

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[1] Berichte d. deut. bot. Gesells. V. 1887., p. lxv.

VOL. XIII. NO. 8.—BOTANICAL GAZETTE.—AUG., 1888.

New mosses of North America. I.

F. RENAULD AND J. CARDOT.

(WITH PLATES XIII-XX.)

Dicranella Fitzgeraldi.—Cespitose, yellowish or dirty green. Stems 5–15 mm. long, simple or bipartite. Leaves crowded, subsecund, from a lanceolate base gradually narrowed into a long subulate canaliculate point, denticulate at the apex; 3–3½ mm. long, ⅛ mm. broad; costa broad, ⅛ width of leaf-base, occupying nearly all the point; cells of the areolation rectangular or subrectangular, firm, more or less elongated. Perichætial leaves from a dilated sinuate-denticulate base·abruptly subulate, denticulate at the apex. Pedicel yellowish, 7–15 mm. long, twisted to the left, but rather to the right above. Capsule erect, symmetric, oblong, not constricted under the orifice, very slightly plicate when dry, brown or yellowish; length 1½ mm., diameter ½ mm.; lid convex, obliquely long rostrate; teeth purple or orange-colored, densely trabeculate, striolate lengthwise, faintly granulose, cleft to below the middle into two very long-subulate legs, quite free or partly connected. Male flowers unknown.

Florida: on sandy ground near Palatka (*Fitzgerald*).

This species is readily distinguished from D. heteromalla by the symmetric erect capsule, and the teeth of the peristome cleft to below the middle into two narrower and more elongated legs. It is more closely allied to *D. stenocarpa* Besch., a tropical species from Martinique and Guadaloupe islands, from which it differs in its more acute leaves, denticulate at apex, the capsule not constricted under the orifice, and the peristome less papillose.

Sterile specimens gathered in Louisiana by Mr. A. B. Langlois, which we had at first referred to D. heteromalla, may belong to D. Fitzgeraldi.

Campylopus Henrici.—Cespitose, yellowish green. Stems very short, without tomentum. Leaves slightly secund, lanceolate-subulate and semitubulose from an oblong base, the upper generally tipped with a short hyaline denticulate and often broken point; 3–4 mm. long, ½ mm. broad; basilar cells rectangular, 3–4 times longer than broad, those of the angles sometimes rather soft and yellowish, but not forming distinct auricles, the upper elongated, straight, linear; costa broad, about ⅓ the width of leaf-base, of 4–5 strata of cells, 2–3 inferior of small thick-walled cells, one median of large thin-walled cells, and one superior of small thin-walled cells, this often incomplete, and then occupying only the middle of the costa. Male flowers small, gemmiform, placed near the top of the stems; bracts ovate, concave, rather suddenly acuminate, thin-nerved; antheridia rather numerous, with some paraphyses. Female flowers and capsule unknown.

Kansas: Saline County, on sandy ground, where it was discovered by the late *Joseph Henry.*

Resembles a stunted form of *C. brevipilus* B. S., and has also rather the appearance of *C. brevifolius* Sch. Differs from the first by the straight rectangular thin-walled cells of the areolation; from the last by the nerve less broad, the leaves often hyaline at the apex and the cells elongated; and from both by the structure of the costa.

Rhacomitrium Oreganum.—Robust, in wide yellowish tufts. Stems prostrate and a little naked below; branches erect, 4–5 cm. long, simple or dichotomous, and with very few short branchlets. Leaves appressed when dry, erect-spreading when moist, generally more or less homomallous at the top of the branches, ovate, or broadly ovate-lanceolate, acuminate, carinate, slightly plicate below, sometimes obtuse, generally acute, muticous or with a short hyaline apiculus or a more or less elongated, shortly decurrent, slightly serrulate hair-point; borders revolute from the base to near the apex; costa percurrent, prominent on the back; cells thick-walled, linear, very sinuous, the lower most elongated, the upper 2–4 times longer than broad, slightly papillose. External perichætial leaves shortly piliferous, the inner muticous, of a more delicate texture of thin-walled and scarcely sinuous cells. Pedicel reddish, paler above, twisted to the left, 12–18 mm. long. Capsule oblong-cylindrical, brownish, 3–3½ mm. long, 1 mm. broad; lid long-beaked; annulus large: teeth purple, very long, cleft to the base into two filiform, often unequal, nodulose and faintly papillose legs; calyptra conical, long-acuminate, brownish at apex, laciniate-lobulate at base.

Oregon: on rocky hill-sides. (*Th. Howell.*)

A remarkable species, intermediate between R. canescens and R. heterostichum, but more closely allied to the last, from which it differs by the aspect, the yellowish color, the robustness and thickness of the stems, the pedicel twice longer and the teeth much more elongated. It is at first sight distinguished from all the forms of R. canescens by the percurrent costa, the hair not papillose, and the capsule cylindrical, not inflated below. Its simple or scarcely ramulose branches give to this species rather the facies of a Dryptodon.

Webera camptotrachela.—Stems erect, slender, simple or with few branches, 5–10 mm. long. Leaves little crowded, erect, narrowly oblong-lanceolate, acuminate, acute, 1¼–1½ mm. long, ⅛ mm. broad; borders plane or slightly revolute below, distantly denticulate in the upper part; costa strong, percurrent; cells of the areolation elongated, subhexagonal or rhomboidal, 6–10 times longer than broad. External perichætial leaves more elongated, long narrowed-acuminate, more or less revolute on the borders, serrulate, with the costa generally excurrent; 2 or 3 inner bracts, smaller and shorter. Pedicel reddish, flexuous, often geniculate at base, 20–25 mm. long. Capsule small, sub-horizontal or cernuous, oblong-subpyriform, tawny-brown, with a long attenuated curved collum; lid convex, apiculate; annulus formed of two rows of cells; teeth yellowish, densely trabeculate; segments of the inner peristome generally imperfect; cilia variable in length. Male plant distinct.

California.

Very closely allied to W. annotina (of which it may be only a sub-species), but differing in its curved collum and the imperfection of the inner peristome, which is often reduced to a single membrane irregularly laciniate.

Polytrichum Ohioense Ren. & Card. Revue Bryologique, 1885, p. 11.—Stem erect, simple or bipartite, 3–6 cm. long, a little tomentose below. Leaves spreading when moist, erect-flexuous when dry, from a sheathing base, linear-acuminate, cuspidate, serrate; lamellæ about 50, each in section of a row of 5–7 cells, the marginal one much larger, transversely dilated, about twice broader than high, very slightly convex, often almost plane. Perichætial leaves longer, with a longer hyaline base. Pedicel 4–8 cm. long, reddish below, pale above. Capsule erect, finally horizontal, tetragonal or pentagonal, rarely hexagonal, acute-angled, rather narrowed toward the base, with a very small or indistinct hypophysis; length 5–7 mm., diam. 2–2½ mm.; lid conic-acuminate, red at margin.

We originally described this very good species in 1885, in the *Revue Bryologique*, upon specimens gathered in Ohio by Mr. Provost. Since then, Mr. H. A. Green communicated to us this moss as P. formosum from N. Carolina, Crowdin Mount, and Mr. Ch. R. Barnes from several localities of New Hampshire (*Bailey*) and Wisconsin (*Lapham*). We have also recognized it in a specimen issued as P. formosum in Sulliv. et Lesq. *Musci Bor. Americani* no. 323, without locality. Besides, Mr. Barnes wrote us lately: "I have had all our Polytrichums carefully studied. We found your P. Ohioense far commoner than P. formosum; indeed, we have no specimen of P. formosum in our collections from N. America. We have P. Ohioense from Lafayette, Indiana; summit of Mt. Mansfield, Vermont; Dells of the Wisconsin, Milwaukee and Manitowoc, Wisconsin." Therefore, it is probable that our species is broadly scattered in the United States, where hitherto it has been confounded with P. formosum, from which it is readily distinguished by the form of the capsule, more or less narrowed toward the base, and with an indistinct hypophysis, and chiefly by the form of the marginal cells of the lamellæ, a character which separates it from all the other species of Polytrichum. The true P. formosum seems to be very rare in North America. We have it only from Miquelon Island, near Newfoundland, where it was gathered by Dr. Delamare. In this species, as in P. gracile, the capsule is rounded at base, with a distinct hypophysis, and the marginal cells of the lamellæ are in section ovate, higher than broad, and of same size as the others or only a little larger. The P. commune is still more different by its very distinct annular hypophysis and the marginal cells of the lamellæ hollowed and semilunar in section.

Fontinalis Howellii.—Rigid, yellowish green. Stem 10–15 cm. long, subligneous, flexuous, naked below, pinnate and partly bipinnate. Branches spreading, for the most part arched downward, of a plumose aspect. Stem-leaves becoming gradually larger toward the top of the innovations, erect-appressed, broadly ovate, shortly acuminate, concave, subcarinate or only plicate, cucullate or lacerate at the apex; upper leaves 5–7 mm. long, 2–3 mm. broad; the lower much smaller. Branch-leaves very different, narrowly lanceolate, concave, not carinate, long acuminate-tubulose, rigid, erect-spreading, 3–4 mm. long, 1–1¼ mm. broad, in three very distinct ranks. Cells of the areolation long linear, rather firm, those of the angles more or less enlarged and generally brownish or ferruginous. Perichætial leaves rounded-obtuse and lacerate at the apex. Capsule entirely concealed in the perichætium, 2 mm. long, ½–¾ mm. broad; lid unknown; teeth about 1 mm. long, narrow, linear-acuminate, slightly papillose, often connected in pairs at the apex, with 20–25 lamellæ on the inside, not perforated on the dorsal line; lattice-cone of the inner peristome strongly papillose, the lower transverse bars appendiculate.

Oregon: on old logs in swamps (*Th. Howell*).

Already in 1881 Mr. Lesquereux communicated to us this plant; but the specimen was poor and sterile. Recently we have received from Mr. Th. Howell good fertile specimens of this very fine moss, which is at first sight distinguished from all congeners by its strikingly rigid aspect, the arcuate branches and the dimorphous leaves, the branch-leaves being narrow and tubulose in the upper part.

Fontinalis flaccida.—Plant very soft, yellowish. Stems slender, naked below, 25–35 cm. long; branches subpinnately ramulose; branchlets spreading, slender, distant. Leaves soft, distant, open, but convolute-imbricate at the top of the ramuli, elongated, narrowly lanceolate, plane or nearly so, obtuse or truncate, and slightly denticulate at the apex; 5–7 mm. long, 1–1½ mm. broad. Cells thin-walled, the median very long, 10–20 times longer than broad, the upper much shorter; those of the angles large, lax, subrectangular or subhexagonal, hyaline or brownish, forming very distinct auricles. Flowers and capsule unknown.

East Louisiana: in the branches and roots overflowed in the Bayou Bonfouca (*A. B. Langlois*).

A remarkable species, readily distinguished, although sterile, by its very soft lax-foliate stems and its long, plane or scarcely concave leaves. The æstival form of *F. biformis* Sulliv., which resembles it by the structure of the leaves, is quite distinct by its rather rigid facies and its leaves shorter, more crowded, less distinctly auricled, erect and convolute-imbricate throughout the length of the branchlets. The *F. filiformis* Sull. & Lesq. and *F. disticha* Hook., which have also some affinities with our species, differ much from it by their facies and their leaves concave, canaliculate or tubulose the upper part.

Camptothecium Amesiæ.—Widely cespitose, bright yellowish-green. Stems prostrate, creeping, radiculose, pinnately ramulose, 8–12 cm. long; branchlets crowded, short, equal, erect, a little curved, 5–10 mm. long. Stem-leaves broadly triangular, narrowly long-acuminate. Branch-leaves ovate-lanceolate, shortly acuminate, carinate, plicate, generally plane on one side and revolute on the other, slightly serrulate at the apex, 1¼ mm. long, ½ mm. broad; costa vanishing in the acumen; cells of the areolation linear, attenuated, 10–15 times longer than broad, the upper shorter, the alar numerous, quadrate or subrectangular. Inner perichætial leaves ecostate, narrowly lanceolate and long-acuminate, entire. Pedicel short, 8–12 mm. long, purple, rough, a little twisted to the left. Capsule narrow, long-cylindrical, suberect or subhorizontal and slightly arcuate; lid unknown; teeth orange, long acuminate-subulate, strong, densely trabeculate; segments split their whole length; cilia long.

California: Auburn, mixed with *Hypnum pinnatifidum* Sull. & Lesq. (*Mrs. Mary E. Pulsifer Ames*).

This species is intermediate between *Hypnum Nuttallii* Wils. and *H. pinnatifidum* Sull. & Lesq., differing from the first by its branch-leaves not dentate at the base, the teeth of the peristome narrower and more narrowly acuminate-subulate and the cilia longer; from the last by its narrow, long-cylindrical capsule; and from both by its branch-leaves broader and shortly acuminate. By this last character it is related to *H. Nevadense* Lesq., but this species is distinguished by the facies, the mode of growth, the erect symmetric capsule, the inner perichætial leaves coarsely sinuate-dentate in the upper part and abruptly narrowed into a very long filiform point, and, finally, by the less perfect peristome, characters which compel us to separate this plant from the genus Camptothecium and to place it in Homalothecium (*H. Nevadense* Ren. & Card.).

Stenay, *France*.

EXPLANATION OF PLATES XIII–XX.—All figures enlarged 80 diameters or more are copied by means of Nachet's camera lucida:

PLATE XIII. *Dicranella Fitzgeraldi.*—*a*, entire plant; *b b*, stem leaves; *c c*, point of same; *d*, areolation of the base of same; *e*, perichætial leaf; *f f*, capsule; *g*, lid of same; *h*, portion of the peristome.

PLATE XIV. *Campylopus Henrici.*—*a a*, leaves; *b*, point of same; *c*, areolation of the base; *d d*, transverse section; *e*, male flowers; *f*, bract of same.

PLATE XV. *Rhacomitrium Oreganum.*—*a*, entire plant; *b b b*, leaves; *c c c*, point of same; *d*, areolation of the upper part; *e*, capsule, pedicel and perichætium; *f*, capsule with the lid; *g*, portion of the peristome.

Plate xvi. *Webera camptotrachela*.—*a*, entire plant; *b b*, leaves; *c*, areolation of the middle; *d d*, external perichætial leaves; *e*, inner perichætial leaf; *f*, capsule with the lid; *g g*, capsule deoperculate; *h*. portion of the external peristome; *i*, portion of the inner peristome.

Plate xvii. *Polytrichum Ohioense*, compared with P. formosum, P. gracile and P. commune.—*a*, transverse section of the lamellæ of the leaves of P. Ohioense; *b*, ditto of P. formosum; *c*, ditto of P. gracile; *d*, ditto of P. commune; *e e*, capsule of P. Ohioense; *f*, capsule of P. formosum.

Plate xviii. *Fontinalis Howellii*.—*a*, entire plant; *b b*, upper stem-leaves; *c c*, branch-leaves; *d*, perichætial leaf; *e*, capsule; *f*, portion of the external peristome; *g*, portion of the lattice cone.

Plate xix. *Fontinalis flaccida*.—*a a*, leaves; *b b*, point of same; *c*, areolation of an auricle; *d*, areolation of the middle.

Plate xx. *Camptothecium Amesiæ*.—*a*, entire plant; *b*, branch-leaf; *c*, areolation of the base of same; *d*, perichætial leaves; *e e*, capsule with pedicel; *f*, portion of the outer and inner peristome.

Zygomorphy and its causes. II.

CHARLES ROBERTSON.

As soon as a shallow flower becomes horizontal the insect relations change, and certain modifications which would be corrected in vertical flowers become advantageous. While the flower is erect, the horizontal petals form a convenient landing. When the flower turns to one side, the petals become vertical, and the stamens and styles, which become horizontal, form the landing. The flower immediately becomes sternotribe, and this shows how an apparently trivial variation may be of great functional importance. The pollen, instead of being scattered indefinitely on all sides of the insect, is now limited to the under side. It will be advantageous for the stamens and styles to bend so as to strike the ventral surface of the bee with more precision.

The upper nectary, being in front of the landing, is most convenient, and is first to be sucked. To suck the lower nectaries, the bee must turn and hang under the stamens, a very inconvenient operation which causes delay. This view and, in fact, the whole theory stated in this paper was suggested by the action of a bee, *Synhalonia speciosa* Cress.,[12] on the flowers of Geranium maculatum.

The flowers are terminal and vertical, or nearly so, and insects light upon the petals. Humble-bees, which seem best adapted to fertilize the flower, pull it down by their weight so as to invert it, as observed by Prof. Macloskie.[13]

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[12] The bees mentioned in this paper were named by Mr. E. T. Cresson.

[13] Bot. Gaz. IX, 157.

Smaller visitors do not bend the peduncles. The Synhalonia bent them so that the stamens and styles turned to an horizontal position. To keep her body upright, the bee took a position on the upper side of these, and sucked only the upper nectary. When she visited a few flowers which were bent to one side, she lighted on the stamens and sucked the upper nectary. Only once did she insert her proboscis into all of the nectaries, and then with difficulty, since she had to turn upside down and hang to the stamens.

The very fact that a bee lighting on the stamens sucks the upper nectary first must have a serious influence on the lower ones. Since bees are often disturbed before they have emptied all of the nectaries, the one which is most convenient is most likely to be sucked. Darwin has observed[14] that "when flowers having more than a single nectary are visited by many bees, so that the nectar is exhausted in most of them, the bees which afterward visit such flowers insert their proboscides only into one of the nectaries, and if they find this exhausted they instantly pass to another flower." Now, suppose a bee neglects the lower nectaries from being disturbed, or, like the Synhalonia, because it objects to reversing, the next bee trying the upper nectary and finding it empty will come to the erroneous conclusion that the lower also are empty, and may neglect them on that account.

The first change toward zygomorphy is for the stamens and styles to turn down at the bases and up at the tips, so as to strike the ventral surface of the bee more effectually, and this is an additional cause of the abortion of the lower nectaries, by rendering them less accessible.

Hibiscus lasiocarpus[15] is a good example of a flower in the first stage of irregularity. When the flower is open, insects light on the base of the staminal column. The free ends of the filaments are directed from the upper and lateral portions of the column, so as to dust the ventral surface of the bee which lights upon them. The styles are bent upward, holding the five capitate stigmas in such a position that bees strike them before they land. After sucking, the bees crawl out over the filaments and upon the lower petals, leaving the flower without again touching the stigmas.

Most of the flowers are as in fig. 1, one nectary (3) is uppermost, and the column is bent down, so as to come between 1 and 5.

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[14] Orchids, 42.

[15] The flower is adapted to larger bees, Apidæ, of which I have found the following: *Bombus separatus* Cress. (f), *B. Pennsylvanicus* De Geer. (n), *Apathus elatus* Fabr. (m), *Melissodes bimaculata* St. Farg. (m), *Emphor bombiformis* Cress. (mf), *Megachile brevis* Say (m).

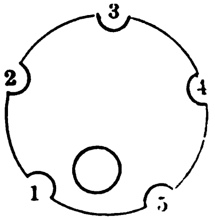

Fig. 1.

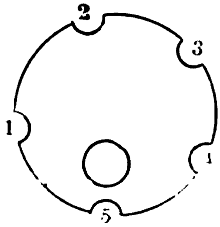

Fig. 2.

Emphor bombiformis is by far the most abundant visitor. Indeed, in two seasons' collecting of insects on flowers, I have failed to find this bee except on this plant. The female visits the flower for honey and pollen, her loose scopa being well adapted to hold the large grains. The male comes for honey and in search of the female. In sucking, this bee generally begins with 4 and turns to the left, often missing 5, but sometimes reversing, so as to empty all. Of 27 individuals, only 10 sucked 5 nectaries, 17 missing one or more. The 27 sucked 113 out of a possible 135 and missed 22.

Bombus Pennsylvanicus, which is next in abundance to the Emphor, generally begins with 2 and sucks to the right, rarely reversing, so that it usually misses 1. It often misses 5, also, especially when this nectary is under the column, as in fig. 2. Of 56 individuals, only six sucked 5 nectaries, 50 missing one or more. The 56 sucked 195 out of a possible 280 and missed 85.

Compared with Emphor bombiformis, Bombus Pennsylvanicus misses the lesser nectaries more frequently. The Emphor, therefore, has more influence in preserving the regularity of the flower. Now, if this bee becomes less frequent on account of competition with the more diligent humble-bee, or from any other cause, the irregularity of the Hibiscus will be hastened.

The lower nectaries, being commonly neglected, are most likely to contain nectar; yet, if a bee finds no nectar in the first or second of the upper ones, it leaves the flower as if inferring that the lower are empty.

As stated above, Bombus Pennsylvanicus does not turn back, but sometimes sucks the fifth nectary (no. 1 in fig. 1) by squeezing under the column. This causes considerable delay, which is a disadvantage both to bee and flower. We can see, therefore, how an abortion of the lower nectaries would be advantageous.

In the insect relations of this flower we find the conditions which have given rise to more complicated forms, and which may still further modify the Hibiscus.

When a flower with a single central nectary becomes horizontal, its new position makes access to the nectary useless, except on the upper side, and this makes possible different modifications of the lower parts, which make the nectar inaccessible except above. In many Papilionaceæ, for example, nine lower stamens are united, leaving a way to the nectar only on the upper side.

When the flower turns to an horizontal position, the effect on the petals is to deprive them of their function as a landing, and this makes possible many specializations for other purposes.

The upper petals remain expanded, so as not to come in the way of an insect lighting on the stamens and styles. Since an insect about to alight approaches the flower from above and in front, the upper petals are more conspicuous than the lower, which are hidden by the reproductive organs. The upper petals, therefore, retain their attractive function, while the lower lose this office, also, as well as that of a landing, so that the advertisement is retained on the upper side of the flower. In Papilionaceæ the upper petal is much enlarged, forming the vexillum. Irregular flowers of shallow origin, in general, have the upper petals larger and brighter colored.

Since the lower petals are deprived of their function both as organs of attraction and as a place of landing, and since access to the nectaries is no longer important on the lower side, these petals are free to assume any position and undergo any amount of modification which will fit them for a new function. In Gaura[16] they have turned so as to help the upper petals in attracting visitors. Often they become less expanded, aiding the stamens and styles as part of the landing. In Papilionaceæ two lower petals are united, forming a lighting-place for insects, increasing the attractiveness of the flower, protecting the stamens from rain and from pollen-eating intruders, and enabling them to strike the visitor with more precision[17].

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[16] For illustration of Gaura Lindheimeri, see Wild Flowers of Am., pl. XXIII.

[17] While most Papilionaceæ are sternotribe, and all were no doubt originally so, in Phaseolus the keel guides the stamens against the insect's side, making the flower pleurotribe. In Apios the tip of the keel is fixed to the summit of the banner, and when dislodged must strike the insect's back, making the flower nototribe.

If the above observations indicate the conditions which have given rise to sternotribe flowers, irregular polypetalous flowers would be expected to be sternotribe, and this is the rule with them, as far as I know. Examples are: Delphinium, Aconitum (Ranunculaceæ), Hibiscus lasiocarpus (Malvaceæ), Pelargonium (Geraniaceæ), Æsculus (Sapindaceæ), Polygala (Polygalaceæ), Papilionaceæ, Gaura (Onagraceæ), Rhexia (Melastomaceæ), Cuphea viscosissima (Lythraceæ). Also, Hemerocallis, Pontederia, etc., among Monocotyledons.

Some of these flowers show no indications of the conditions which are supposed to have produced them. Thus, Trifolium pratense is no longer shallow, but is deep and tubular, the insect no longer lighting on the flower, but on the head, and the pollen is dusted on the under side of the bee's head or proboscis. My theory only requires what would be supposed from its affinities, viz., that the flowers were originally polypetalous and have become smaller and crowded. It not only follows from my theory that these flowers must have been visited separately by bees lighting on the stamens, but, as already observed, there are reasons for claiming that originally small, regular lateral flowers in close clusters would not be rendered irregular by insects. Moreover, the effect of insects visiting such flowers is so far from tending to make them irregular that it tends rather to turn such irregular flowers back to a more regular form; for, unless the organs are protected by a rigid galea or keel, the flowers will be fertilized by insects brushing over them, instead of applying pollen to the upper or under side of the insects. The flowers of Trifolium are protected, but Amorpha seems to have lost its papilionaceous character in this way. It has lost wings and keel, only retaining the vexillum, which makes the spikes more conspicuous, and its insect relations are much the same as in the apetalous Salix.

But there are some flowers of polypetalous origin which are nototribe, such as most orchids, Impatiens and Viola (sometimes).

The orchids must have been developed as sternotribe, and become nototribe by the twist in the ovary, which inverts the flower. The labellum must have been developed as an organ of attraction, like the vexillum of Papilionaceæ and the upper colored sepals of Pontederia, and has become a landing on account of the flower turning upside down. It is remarkable that these flowers, whose structure required them to become sternotribe, should finally become the highest specialized of nototribe flowers, far outstripping those which became nototribe more readily, and assuming adaptations which aim at all parts of the upper sides of insects. Thus, Orchis pyramidalis[18] fastens its pollinia on the upper side of the proboscides of Lepidoptera; O. spectabilis fastens them on the smooth part of the face of female humblebees; Habenaria orbiculata, on the eyes of Sphingidæ;[19] Calopogon parviflorus, on the first segment of the abdomen of small bees;[20] the Calopogon seems to have gone through some remarkable changes. From being regular and dusting pollen indefinitely on the visitor, it first changed so as to dust the ventral surface. Then, inverting, it fastened the pollen on the upper side of the bee. Then it turned right side up again; but it has not, however, become again sternotribe, but remains the most remarkable of nototribe flowers. It has quit turning upside down to strike the insect's back. It turns the insect upside down to strike its stigma. As far as I know, Calopogon is the only nototribe flower of shallow origin which is not inverted.

Another nototribe flower, which is polypetalous, is Impatiens—at least, some of the species. They must have become sternotribe and then become inverted by becoming pendulous.[21]

Carlinville, Ill.

Some notes on Western Umbelliferæ. III.

JOHN M. COULTER AND J. N. ROSE.

Peucedanum Austinæ, n. sp. Resembling P. Hallii, but with leaf-segments larger and pinnate with narrow often toothed divisions; flowers purplish; fruit as in P. Hallii (3½ lines long, 1½ lines broad), except oil-tubes solitary in the dorsal intervals, mostly 2 in the laterals, 4 on the commissural side, and an additional one in each group of strengthening cells: seed-face concave, with central longitudinal ridge.—California. Plumas county (*Mrs. R. M. Austin*, June, 1880); near Yreka (*Greene* 732). Distributed as *P. Hallii* Watson.

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[18] Darwin, "Fertilization of Orchids," 16.

[19] Gray's "Structural Botany," figs. 466 and 466a.

[20] Bot. Gazette XII, 288.

[21] Flores pedicello debili fulti, sæpius propter pondus calcaris invertunter, et calcar, reverâ posticum, anticum apparet. Benth. & Hook. Gen. Plantarum, I, 277, Impatiens.

Peucedanum Grayi=*P. millefolium* Watson, King's Rep. v. 129, a name which must give way to the older *P. millefolium* of Sonder, from South Africa.

Peucedanum Parishii, n. sp. Caulescent, from a few inches to a foot high, glaucous, closely pubescent, from a thick elongated root: leaves pinnate, with pinnatifid to entire leaflets, the ultimate oblong-linear segments cuspidate, somewhat toothed or entire; root-leaves sometimes nearly entire or few-cleft: umbel 3 to 8-rayed, with no involucre, and involucels of small linear-lanceolate scarious-margined bractlets; rays an inch or more long; pedicels 2 to 4 lines long; flowers white: fruit somewhat obovate, glabrous, 3½ to 5 lines long, 2 to 3 lines broad, with narrow wings, and filiform or obsolete dorsal and intermediate ribs: oil-tubes exceedingly small, often obscure, 6 to 8 in the intervals, 8 to 10 on the commissural side: seed-face concave.—California, Bear Valley, alt. 6,500 ft. (*Parish* 1828); high ridges, north side of "Old Baldy" Mountain, San Bernardino county (*Parish* 1942). Collected at the former station June, 1886; at the latter, June, 1887.

Peucedanum Pringlei, n. sp. Very short caulescent or acaulescent, with several stout peduncles, 6 to 12 inches high from a common root, tomentose-pubescent: leaves rather small, pinnately decompound, with numerous short linear segments: umbel somewhat equally 6 to 12-rayed, with no involucre, and involucels of linear-lanceolate more or less tomentose bractlets; rays 1 to 3 inches long; pedicels 3 to 5 lines long; flowers white: calyx-teeth obsolete: fruit nearly orbicular, becoming glabrous at maturity, 4 to 6 lines long, 3½ to 4 lines broad, with thin membranous wings broader than the body, and filiform dorsal and intermediate ribs: oil-tubes large and solitary in the intervals (an occasional secondary one in the lateral intervals), 4 on the commissural side: seed deeply sulcate beneath the oil-tubes, with plane face.—California, San Diego county (*Pringle, Parry, Vasey*); New Mexico, Upper Gila (*Greene*). Flowers in April. Distributed variously as P. dasycarpum, P. caruifolium and P. fœniculaceum.

Peucedanum Watsoni, n. sp. Apparently acaulescent, but with a short subterranean stem from a deep-seated globose or oblong tuber with clusters of rootlets over its surface, and with or without a thick elongated root below, 2 or 3 inches high, glabrous or puberulent: leaves bipinnate, the ultimate segments short and linear-oblong: umbel unequally 1 to 5-rayed, with no involucre, and involucels of more or less united often toothed bractlets; rays from almost wanting to an inch long: flowers white: fruit sessile or nearly so, ovate, rough-puberulent, 3 lines long, 1½ lines broad, with very narrow wings, and filiform or almost obsolete dorsal and intermediate ribs: oil-tubes (sometimes wanting) very obscure, 3 to 6 in the intervals, 1 in each rib, and 6 on the commissural side: seed-face plane.—Washington Territory, Cimcoe Mts. (*Howell*, in 1881), Cascade Mts. (*Brandegee*, in 1882, no. 320 of Canby's N. Transcontinental Survey), mountain summits near Columbus (*Suksdorf*), summit of high hills, Klickitat Co. (*Howell* 411, 412, 413); Oregon, high hills near the Dalles (*Howell C.*, in 1882), also Alkali (*Howell* 830, in 1882). Flowers May, June.

With pleasure we dedicate this mountain Peucedanum to one who has so long been a student of this perplexing genus.

Peucedanum Brandegei, n. sp. Short caulescent, glabrous, 6 inches to a foot high, from a thick elongated root: leaves ternately decompound, the ultimate segments lanceolate (6 to 12 lines long, 1½ to 3 lines wide), cuspidate pointed: umbel 6 to 12-rayed, with no involucre and involucels of few linear or setaceous bractlets; rays 3 to 6 lines long, pedicels not more than a line, both reflexed at maturity: flowers yellow: calyx-teeth evident: fruit (immature) oblong, glabrous, about 4 lines long and 2 lines broad (undoubtedly becoming larger), with wings about half as broad as body, and prominent or even slightly winged dorsal and intermediate ribs: oil-tubes 2 to 4 in the intervals, 4 to 6 on the commissural side.—Collected in Canby's N. Transcontinental Survey, in the Walla Walla region, Washington Territory, May, 1883 (*Brandegee* 799, *Tweedy* 856).

Peucedanum Hendersonii, n. sp. Acaulescent, from a shallow nearly globose constricted tuber (½ to 1 inch in diameter), glabrous: leaves ternate then bipinnate, ultimate segments short and obtuse: umbel equally 2 to 5-rayed, with no involucre, and involucels of linear acuminate scarious bractlets; rays about half-inch long; pedicels 1½ to 2 lines long; flowers white (Orogenia-like): fruit ovate, glabrous, 2½ lines long, 2 lines broad, with thickish narrow wings (not half as broad as body) more or less involute, filiform or nearly obsolete dorsal and intermediate ribs, and a rather prominent ridge on the commissural face: oil-tubes solitary in the intervals, 2 on the commissural side: seed-face plane.—Oregon, John Day Valley, on high hill-tops, May, 1882 (*Howell* B in part), Lost Valley, June, 1882 (*Howell* 410). The fruit of this species, in its thickish involute wings and rather prominent commissural ridge, very nearly approaches that of *Orogenia fusiformis* Watson. Dedicated to L. F. Henderson, one of our best Oregon collectors.

Crawfordsville, Ind.

BRIEFER ARTICLES.

A date palm fungus (*Graphiola Phœnicis* Poit).—In the early part of 1887 this fungus was abundant on the fronds of the date palm in one of the conservatories of the United States Department of Agriculture, Washington, D. C. As it appeared again this spring with greater severity, and has been reported from other parts of the United States, it may be of interest to state briefly what is known concerning it, more particularly because its anomalous structure renders it a very interesting parasite.

This fungus appears indifferently on either side of the frond or axis in the form of small, roundish, sub-epidermal swellings, scattered or contiguous, which finally rupture the epidermis and protrude as black spore-bodies. These are rarely more than 1 to 1.5 mm. in diameter by 0.5 mm. high, the base being somewhat broader than the apex. As these bodies mature they become crateriform and from their center projects a curious bundle of bright yellow filaments, several millimeters in length. Filling the bottom of this cavity and suspended between the filaments at this stage of growth are innumerable sulphur yellow spores which, when the fronds are shaken, fly off in a manner quite suggestive of diminutive showers of pine pollen. Most of these spore-bodies were very superficial, being confined exclusively to the epidermis, the deeper tissues of the frond being green quite up to the borders of the fungus and beneath it. In some instances, however, the deeper tissues also suffered, and in a very few they had become yellow for a distance of several millimeters, especially in the direction of the longer axis of the pinnæ, and particularly when the fruit bodies were clustered. On some fronds there were hundreds of these bodies, so that they had a fly-specked appearance. Other fronds upon the same plant appeared to be less affected, and some adjacent plants were entirely exempt.

According to Fischer, the black rim of the crater, the peridium, grows out of a hyphæ-complex, or pseudo-parenchymatous substratum, and consists of parallel hyphæ arranged nearly at right angles to the plane of the frond. These hyphæ are more or less branched, and are united by a black exudate, soluble in various reagents. There is also a delicate inner peridium, quite apparent in some species of Graphiola, but not easily demonstrated in this one. The long yellow filaments are composed of parallel mycelial threads, each strand or filament containing fifty or more united into one body. From the pseudo-parenchymatous floor of the crater, between the bases of the yellow filaments, arise many elongated, unbranched or basally branched, colorless hyphæ, which constrict into nearly isodiametric cells. On the side wall of these cells the nascent spores appear in the form of buds, which enlarge, become separated from the mother cell, grow and subdivide after separation, to become finally the round or ellipsoidal, smooth-walled, one-celled or two-celled, mature spore. The nascent spores develop on the hyphæ basipetally. There are usually from three to six on each mother cell, and all of these mature at the same time. The mother cell often separates from the hyphæ along with the nascent spores, to which it remains attached for some time. The ripe spores are three to six millimeters in diameter, with a somewhat thick episporium, and a contents showing refractive particles. They germinate in water by the formation of a promycelium and sporidia or by the direct production of a germ-tube.

This fungus was first described by Fries, in 1823, as Phacidium. Many have since written upon it, but its structure, and probable affinity, were first clearly pointed out by Ed. Fischer in 1883. Its classification has been a mooted question, if, indeed, it be yet definitely settled. Fries, Kunze, Duby and Montagne placed it under Ascomycetes; Chevallier, Corda and Bonorden thought it belonged to Uredineæ; while Poiteau and Levillé looked upon it as one of the Myxomycetes. Fischer places it with the Ustilagineæ, or more strictly in a closely allied group under the name Graphiolaceæ. In general appearance, it must be confessed, it is not at all like the smuts, but it does not seem to be dimorphous, and it agrees pretty well with some of the smuts in the manner of spore-formation and mode of germination. In having a persistent mycelium in the form of a peridium it recalls Dossansia, Sphacelotheca, and similar aberrant forms of the Ustilagineæ, which, though perplexing to the systematist, are very interesting to the student of evolution.

After many failures Fischer succeeded in growing the fungus. The spores were sown in December on the immature fronds of a young palm, and the characteristic fungus spots first appeared in the following October.

Graphiola Phœnicis is very widely distributed. It occurs in India, Algiers, Egypt (?), Italy, Austria, Germany, Holland, Belgium, England, Scandinavia, French Guiana, and the United States.

It would be interesting to know to what extent this fungus occurs in the palm houses of this country. Dr. Farlow informs me that he has received it from several localities. The specimens collected by Ravenel in S. C., on Chamærops, and published in *Fungi Caroliniana*, Fasc. 4., No. 72, as G. Phœnicis, either do not belong to this genus or are a distinct species, named provisionally *G.* (?) *compressa* Fisch.

The most important paper is *Beitrag zur Kentniss der Gattung Graphiola.* Ed. Fischer, *Bot. Zeit.* 1883, Nos. 45, 46, 47 and 48.

Bot. Lab., Univ. of Michigan. ERWIN F. SMITH.

Parasitic fungi of Missouri.—During the past five or six years the writer has devoted considerable attention to the fungi of Missouri, and during that time, with the assistance of Prof. S. M. Tracy and Rev. C. H. Demetrio, about 400 strictly parasitic species have been taken. Most of the species were taken in the central and southeastern parts of the state and, while no collections of importance were made in the western counties, late observations in these parts have convinced me that here the flora, so far as relates to fungi. is practically the same as that of the more carefully explored region. With very few exceptions, all of the species taken have been preserved either in my own herbarium or that of Mr. Demetrio.

Quite a number of the species have been distributed in Ellis' *North American Fungi* and Winter's *Fungi Europaei et Extra Europaei.* A careful list of all the species, together with their hosts, has lately been prepared, and as it now stands this list includes the following:

Uredineæ, 105 species, divided among the following genera: Æcidium, isolated forms, 41; Cæoma, 2; Coleosporium, 2; Gymnosporangium, 1; Melampsora, 4; Peridermium, 1; Phragmidium, 3; Puccinia, 33; Rœstelia, 2; Uredo, 2; Uromyces, 14.

Ustilagineæ. 16 species, divided as follows: Doassansia, 1; Entyloma, 3; Tilletia, 2; Urocystis, 1; Ustilago, 9.

I have several times collected a curious Ustilago upon Polygonum Hydropiper. The fungus attacks the flowers and greatly distorts them, producing in many cases large black globular swellings. This is probably the same form mentioned by Dr. Farlow (BOT. GAZETTE, viii, 277) as resembling *U. Bistortarum* (DC.). What appears to be the same thing has lately been issued in Dr. Winter's *Exsiccatæ* under the name *U. Austro-Americana* Spez., from South America.

Peronosporeæ, 17 species, distributed as follows: Cystopus, 5; Peronospora, 11; Phytopthora, 1.

Erysipheæ, 24 species, upon 47 hosts, as follows: Erysiphe, 3; Microsphæra, 8; Phyllactinia, 1; Podosphæra, 1; Sphærotheca, 5; Uncinula, 6.

Imperfect forms, nearly 200 species, so called, divided among the following genera: Asterina, Cercospora, Cladosporium, Coniothyrium, Cylindrosporium, Diplodia, Entomosporium, Gleosporium, Ramularia, Septoria, etc.

The remainder of the list, some 35 species or more, is made up of members of the following genera: Epichloe, Leptosphæria, Phyllachora, Sphærella, Taphrinia, etc.—B. T. GALLOWAY, *Washington, D. C.*

The black maple.—Last fall I contributed to an horticultural journal an account of the conspicuous differences between Acer saccharinum and its so-called variety nigrum, giving figures of the characteristic dissimilarities in foliage and fruit.[1] The statement was made that the two maples are evidently specifically distinct. At all events, they are so unlike in general appearance that they may be recognized at a glance at a distance of four or five rods. In ornamental value they are clearly different. A new study of trees in flower and in young foliage also reveals characteristic differences. In my judgment the two are distinct species. I have not been able to detect intermediate forms. The following characterizations will separate them.

Acer saccharinum Wangenheim.—Leaves three to five-lobed, the sinuses narrow and deep, the lobes furnished with large and long-acuminate teeth, glabrous, plane, rather thin, the basal sinus open; stipules none: nodes of the young shoots usually reddish: inflorescence smooth or nearly so; bracts none or minute: staminate flowers somewhat campanulate; the calyx two lines or less in length: lobes of the fruit little spreading.

Acer nigrum Michaux.—Leaves larger, three-lobed, the sinuses very broad and shallow, the lobes entire or very bluntly toothed, the apex not so prominently acuminate, pubescent or villous beneath and also on the petiole when young, limp, the sides conspicuously drooping, thick and soft, the basal sinus usually closed or the lobes overlapping and causing the leaf to appear slightly peltate; stipules conspicuous, foliaceous and ciliate, early caducous;[2] nodes of the young shoots not colored: inflorescence pubescent or villous; the bracts conspicuous and ciliate: staminate flowers cylindrical; the calyx two and a half or more lines long: fruit smaller, the lobes usually diverging.—In aspect this species is much heavier and duller than the other, owing to the drooping and wilted appearance of the large cloth-like leaves.—L. H. BAILEY, *Agricultural College, Mich.*

EDITORIAL.

IT IS THOUGHT by some to be desirable for every form of scientific work to have its center at Washington. The reason for this is partly sentimental, for it sounds large to have a "national" museum or a "national" herbarium, and partly financial, for it is argued that only the government can support such things in any worthy way. The financial reason is a good one, as any one will concede, for that government which has given its fostering care most liberally to scientific work has to-day the proud satisfaction of seeing the scientific world flocking to its doors to learn wisdom. Our government has already given enough money to scientific work in botany and agriculture to have shown great results if rightly directed; but the results have mainly been a few padded "reports" of aimless experiments and meaningless lists and centennial "displays." Periodical "reports," gotten up with the sole idea of having every one so many pages long, or with the inspiring thought that it is so many pages longer than the last one, and "displays," express the whole desire and appreciation of our government with respect to scientific work. It is not the fault of our brethren who have the good fortune to be "government" scientists, for they are good men and anxious to do good work. But there is a factor in the whole organization of such scientific work which is fatal to good results, necessarily so; and that is, that every position is filled and every position held by that hobgoblin "political influence." When they who hold the appointing power use it to fill scientific positions for political reasons, it is hardly likely that any "science" that the world will hear of will be the result. If half of the attachés in such "centers of work" are not so much mere rubbish in the way of the other half who have the ability to work, we are much mistaken, although we may have the proportion wrong. Our plea, then, is for politics to be banished, along with the "rubbish" referred to, reports not demanded until there is something to report, the "show business" given over to perfectly capable but less scientific hands, and the specialist thus be given leisure to do work that will be a credit to himself and the government that is paying for it.

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[1] *Popular Gardening*, Nov. 1881, 24, 4 figs.

[2] Observations upon the occurrence of stipules in this species are also recorded in *Amer. Nat.*, vi, 767, vii, 422, and by Wheeler, *Mich. Cat.*, 23.

OPEN LETTERS.

White flowered Linum perenne.

The instances are very numerous in which species both of animals and plants which exist in the colder regions of British America and on the mountains of Europe are common also to the elevated portions of Colorado; and it was therefore with peculiar interest that I recognized in the white-flowered form of Linum perenne, stated by Prof. Jas. Macoun (p. 116) to be characteristic of James Bay and Hudson Bay, a form I have myself met with in Colorado. The typical form of L. perenne is common in Colorado at about 8,000 feet, but above 9,000 its place is taken by a somewhat lower variety, with deeper blue petals, and, although the white form is also alpine, I only met with it on one occasion, near the boundary line between Montrose and Gunnison counties. It would be interesting to learn whether this variety exists at all in the northern or alpine regions of Europe.

Theo. D. A. Cockerell.

West Cliff, Colorado.

Buchloe dactyloides.

Ever since Nuttall, in 1818, wrote of it, *Buchloe dactyloides* Engelm. has been recognized as one of the best forage grasses of the plains. Formerly vast herds of buffalo, and at present the herds and flocks of the western stockman, obtain from it a great part of their winter's food. The reason of this lies in the fact that in the mature plant, as found in autumn and winter, the solid culms and stolons, together with the leaves, are perfect store-houses of food materials. Every parenchyma cell is packed with starch grains. Buchloë, when ripe, furnishes more nutriment, considering the size of the plant, than almost any other grass.

Lincoln, Neb. JARED G. SMITH.

Color variation in flowers of Delphinium.

The dwarf larkspur, *Delphinium tricorne* Michx., is a common plant in many parts of the Mississippi valley, and is the only one, so far as I know, growing in the immediate vicinity of St. Louis. It is well marked by its cluster of tuberous thickened roots, the three pistils to each flower, and smooth seeds. The flowers are usually blue, and our manuals say occasionally white; but till this spring I did not see any of the white forms. Early this spring a great deal of it was found on the rocky limestone bluffs at Glencoe, Mo., appearing somewhat earlier than the blue form. Some weeks later I had occasion to collect in the region of Bluff Lake, well known to local botanists for the number of interesting phænogams found there. Not only did I find large numbers of the white-flowered form, but a beautiful purple-flowered form. This form was found, along with the blue and white forms, in rich woods. Mr. Letterman, who has closely observed this species for many years at Allenton, Mo., says the white form is not uncommon. For several years I have also observed *Delphinium azureum* Michx. at La Crosse, Wis. It is common on silicious soils. The flowers of this species are usually sky-blue or whitish, according to descriptions. So far I have not found a single blue-flowered form at La Crosse. The flowers were always white or greenish white, very much like the white form of *Delphinium tricorne.*

St. Louis, Mo. L. H. PAMMEL.

CURRENT LITERATURE.

North American Geraniums.[1]

Our Geraniums have not been revised since Torrey & Gray's Flora, about 50 years ago. In the memoir before us Dr. Trelease has presented, with his usual completeness, not only descriptions of all our species, but some biological notes concerning them, their pollination, dissemination, etc. Of the genus Geranium we have 10 native species; Erodium has 4; Limnanthes 4, among which is a new species (L. Macounii) from Vancouver Island; Floerkea 1; Oxalis 13, with a new species (O. Suksdorfii) from Oregon. It seems that Elliott's O. recurva ranges north into Ohio, Indiana, etc., having been taken for a large form of O. corniculata, var. stricta (O. stricta of the Manual). With the 2 species of Impatiens, we have thus 34 native Geraniums. The author's biological notes concerning these various species are full of interest, but too detailed for proper presentation in this review.

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[1] TRELEASE, WILLIAM.—North American Geraniaceæ. From the Memoirs of the Boston Soc. Nat. Hist. iv, pp. 71-103, with 4 plates. [Issued January, 1888.]

Minor Notices.

A LIST of species found by Mr. Henry M. Ami near Lake Temiscouata, in Quebec, is reprinted from the *Bull. Torrey Bot. Club*, pp. 134–136.

THE MICROSCOPICAL anatomy of the cedar apple (Gymnosporangium macropus) is treated by Mr. Elmer Sanford in the *Annals of Botany* for February, 1888, and is also issued as a separate reprint.

THE DEPARTMENT OF AGRICULTURE undertook some time ago an investigation of the problem of discovering what plants could be grown upon the arid regions of the southwest. Bulletin number six[2] gives a report of collections and notes made by Mr. G. C. Nealley in Texas, and by Prof. S. M. Tracy in Arizona, New Mexico, Nevada and Utah. About 200 species were collected, upon which various notes of greater or less interest are given. The conclusion reached from the reports is: "We may be assured that there are many which would prove useful in cultivation, and it is to be hoped that the experiment stations of the states embraced in the arid districts will give such a thorough trial." Which ones?

THE FOURTH FASCICLE of Castillo's *Illustrationes floræ insularum maris Pacifici* fulfills the promise of its predecessors. The ten lithographic plates are charming, while the text of the ten species is correspondingly elaborate. The species are all Compositæ, viz.: Erigeron, 2 species; Lipochæta, 5 species (3 of them new); Bidens, 3 species (1 new).

THE SECTION of Vegetable Pathology of the Department of Agriculture has been giving special attention to the diseases of the grape. Bulletin No. 5[3] gives an account of the experiments in the application of various liquid and dry fungicides, such as sulphatine, etc., the basis of all of which is sulphate of copper. The results are somewhat contradictory, but sufficiently accordant to show that the remedies, or preventives rather, are valuable, and the experiments should be continued. As a supplement to the report appears a valuable chapter upon apparatus for applying fungicides, communicated by M. Paul Ferrouillat, professor of rural engineering at the National School of Agriculture, Montpellier, France. The bulletin shows a wide-awakeness and energy in this section which are highly commendable. It is to be hoped that Commissioner Colman will be able to secure an active and able successor for Mr. Scribner, whose administration has been most praiseworthy.

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[2] VASEY, GEO. — Grasses of the Arid Districts (Dept. Agric., Bot. Div., Bull. No. 6), pp. 60, pl. 30, 8vo. Washington: Govt. Printing-office, 1888.

[3] SCRIBNER, F. LAMSON.— Report on the experiments made in 1887 in the treatment of the downy mildew and the black-rot of the grape-vine, pp. 113, pl. 1, figs. 24, 8vo. Washington: Government Printing-office. 1888.

NOTES AND NEWS.

Dr. Lucien M. Underwood will spend the summer in rummaging California for Hepaticæ.

Dr. Maxwell T. Masters has been elected a corresponding member of the Institute of France in place of Dr. Asa Gray.

Dr. Joseph Schenck, in ***American Druggist*** (June), publishes some "pharmacognostical notes," with illustrations, chiefly upon Mentha.

Miss Henrietta E. Hooker, of Mt. Holyoke Seminary, sailed for Europe on the 23d of June, to be absent for six months of study in German laboratories.

In *Garden and Forest* (July 18) Mr. Watson figures and describes *Amelanchier oligocarpa* Roem. as worthy of specific rank. It is the A. Canadensis var. oligocarpa of the Manual.

A summer school of science, specially for teachers, opened at the University of Wisconsin July 10. and closes August 10. It includes elementary and advanced courses in botany, conducted by Prof. Barnes and Mr. H. L. Russell.

"Concerning the potato tuber" is the subject of the last Bulletin of the Indiana Agricultural Experiment Station by the botanist, Dr. J. C. Arthur. Although mainly to instruct the cultivator, it has points of interest for botanists.

In the *Journal de Botanique* (July 1) there is a biographical notice of the late Jules-Émile Planchon, by M. Louis Morot, with a full bibliography. The same number also contains a very interesting picture of "Le Jardin des Plantes" in 1636.

The council of the Royal Microscopical Society of London has determined to abandon the term micro-millimeter for the $\frac{1}{1000}$ of a millimeter, and use in the Journal and Proceedings the term *micron*. It would be wise for all to follow this usage.

Dr. J. V. Haberer has prepared a list of the spring plants in the vicinity of Utica, N. Y., which is published by the Asa Gray Botanical Club of that city, of which he is president. A radius of seven miles is the limit, and the twenty-page pamphlet shows a rich spring flora.

Wakker's observations upon a large number of seeds lead him to believe that aleurone grains are not always protoplasmic, but often vacuoles filled with soluble albuminoids. In this case the crystals and crystalloids found within the "grain" would be derived from the cell-sap.

The genus Tillandsia is completed by Dr. Baker in *Journal of Botany* (June), with 241 species, 64 of which are published for the first time. In two cases the author gave the same name to two different species, overlooking the fact that it had already been bestowed. This gives the editor a chance in a foot-note to call one of these T. Bakeriana.

The function of the tannin group is comparatively obscure. Tannins are not transferred from the leaves before their fall, and, *a priori*, would seem to be products of no further use to the plant. Although glucosides, rich in carbon and oxygen and often associated with glucose, they are not used in the processes of growth, though perhaps they take part in the formation of resins. Prof. W. Hillhouse has some interesting papers on this subject in four recent numbers of the ***Midland Naturalist*** (Nov., 1887-Feb., 1888).

Prof. Graf zu Solms Laubach, of the Botanical Institute at Tübingen, became associated with Dr. Wortmann in the editing of the *Botanische Zeitung* on the 1st of July. Count Solms will be a worthy successor to the lamented DeBary. Original contributions are to be sent to him, while books and all papers for review are to be addressed to Dr. J. Wortmann at Strassburg.

Robert Douglas, in a note on the longevity of coniferous tree seeds (*Garden and Forest*, July 18), says he finds that these seeds preserve their vitality longer in dry climates, like Colorado, than is generally supposed. Seeds of Pinus ponderosa were found to germinate as freely the fifth year as the first, while those of Picea pungens and Pseudotsuga Douglasii germinated readily the third year.

The Compositæ have heretofore borne a good reputation, and their harmlessness is impeached for the first time by MM. Heckel and Schlagdenhauffen, who report (*Comptes Rendus*, May 14, 1888, p. 1446) the discovery of a glucoside in *Vernonia nigritiana* Oliver et Hirn, which acts upon the heart in the same manner as digitaline, arresting it in systole. This glucoside they call *vernonine*, and state its composition as $C_{10} H_{24} O_7$. It is twenty-four times less powerful than digitaline.

Jost has recently worked out the development of the Mistleto (Viscum album), of which, though often studied, reliable data regarding the origin of the embryo-sac and the development of the anther were lacking. The degeneration of the reproductive organs through parasitism is very interesting. Herr Jost's summary is as follows: "Viscum album has its reproductive organs very much reduced; the ovules have degenerated to simple macrospores (embryo-sacs) which arise at the apices of the floral axes; the anthers (microsporangia) are placed not upon specialized staminal leaves, but upon the perianth, in which structure they resemble more those of many vascular cryptogams than those of most angiosperms." The details of this interesting paper see *Bot. Zeit.* nn. 23, 24, 1888.

Ulota phyllantha, heretofore only known from sterile specimens, has been found fruiting by Mr. Thomas Howell in Oregon. The fruit is described by MM. Renauld and Cardot in the *Revue Bryologique*, 1888, no. 3, p. 36. At a meeting of the Torrey Botanical Club on May 8 (reported in the *Bulletin* for June), Mrs. E. G. Britton exhibited slides and drawings of fruit and flower from specimens of the same collection. Upon this, together with a letter to M. Cardot, dated March — ? announcing the discovery, Mrs. Britton claims priority. It is a matter of small consequence, but we can hardly believe that two such distinguished bryologists would have described the fruit without any reference to Mrs. Britton's communication had it really called their attention to the matter for the first time.

In the *Journal of Botany* for July a report is given of an address on root pressure before the Linnæan Society of London by Mr. C. B. Clarke. Mr. Clarke read the commonly accepted doctrine of root pressure as laid down by Sachs, and proceeded to deny the existence of any such force. He would consider the whole *mechanical* fluid action in plants in accordance with the laws of capillarity, and believes that the fluid pressure in every plant cell is nearly zero. To avoid the difficulty that water could not rise to such heights in capillary tubes, he says that water raised a quarter of an inch in one tube may laterally (by pressure or otherwise) pass into another and there rise by capillary action another quarter-inch, and so on nearly *ad infinitum*. We hardly think that this view will be favorably received by plant physiologists.

An international American Congress will be held in Berlin, in October next, to discuss historical, geographical, ethnographical, linguistic and similar subjects relating to the American continent. Of the thirty-seven topics arranged in the preliminary programme, only one is botanical—the economic plants of the ancient Peruvians, introduced by Dr. Wittmack, of Berlin.

The new marine biological laboratory established at Wood's Hall, Mass., deserves success. It opened its first season July 10, under the directorship of Dr. C. O. Whitman, and will close September 22. It is open for both investigators and students. The situation is all that could be desired, both as a delightful place for the summer and as affording abundant and varied material. It will be remembered that Dr. Farlow had his summer class at this place on account of its rich display of algæ.

Dr. H. Rodewald has attempted to investigate[1], by means of chambers constructed for the purpose, the amount of heat given off by plants in the process of respiration, comparing this with the quantity of CO_2 eliminated. The objects experimented on were ripening apples and potatoes. He finds that always by far the larger part of the energy set free by respiration is given off in the form of heat. Supposing the whole of the CO_2 to result from the combustion of starch, he found the actual quantity of heat developed to be 92.2 per cent. of that which would be due theoretically to the consumption of the corresponding amount of starch. The contrivances by which the vitiation of the results through errors was prevented are described in detail. The loss of heat from transpiration could be estimated from the loss of weight, from which the quantity of carbon consumed in respiration must be deducted. The specific heat of the body experimented on was determined by a calorimeter to be about 0.924. The quantity of CO_2 evolved was estimated at the same time in all the experiments.—*Jour. Roy. Mic. Soc.*

The Centenary of the Linnean Society of London, May 24, was a very interesting occasion. The president, Mr. W. Carruthers, delivered his annual address, in which he referred to the losses sustained by the society during the past year, mentioning prominently DeBary and Gray. In accordance with the spirit of the occasion, he spoke of the work of Linnæus, the transference of his collections to England, and the development of the Linnean Society. Then a eulogium upon Linnæus was read, having been prepared by Prof. Thöre Fries, the present professer of botany at Upsala. After an account of the marvelous work of Linnæus, he closed as follows: "The precious gift of Sir James Edward Smith (the Linnean collections) was indeed a noble seed, since grown up into a strong plant, which has borne flowers and fruits from year to year in abundance. Its vitality is a guarantee that it will thrive and flourish so long as the Linnæa borealis, ever green, spreads its fragrance over young and old, high and low, rich and poor, in the mighty forests of the north." Sir Joseph Hooker pronounced the eulogium on Robert Brown, recognized as the greatest botanist of his age. He said that Brown's collection of about 4,000 species of plants belonging to all orders, and three-fourths of them new to science, in nine years, was a feat unexampled in the history of botanical science. Professor Flower gave the eulogy on Charles Darwin, and Mr. Thiselton Dyer upon George Bentham. The Linnean gold medal was presented to Professor Owen and Sir Joseph Hooker.

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[1] Pringheim's Jahrb. f. Wiss. Bot. xviii (1887), pp. 263–345.

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The Botanical Laboratory at Oxford.

SELMAR SCHÖNLAND, PH. D.

In 1886 I published a short account of the botanic garden, library and herbarium of Oxford,[1] to which I must refer readers who wish to get some information about the history and the resources of this botanical institution. I will only repeat here that these resources are very extensive, as the laboratory is situated in a botanic garden which, though not very large, contains representatives of almost all natural orders, and is connected with a very large herbarium and a good library. In the present paper I wish only to offer a few remarks about the arrangements in the laboratory, which have all been made under the direction of Professor Isaac Bayley Balfour, though the different rooms composing it were built before his time.

Having entered the botanic garden through the magnificent old porch opposite the famous tower of Magdalen College, one sees on the right a rather large building with two wings attached to it. The central part of this building contains the lecture-room, the botanical museum and a chemical laboratory (the latter belonging to Magdalen College), while the wings form the botanical laboratory. If we enter the first wing we find ourselves in a room which in future will be fitted out as a physiological laboratory, the other wing being used for morphological studies. In the former we see, first of all, a big cultivator, in which plants can be grown at constant temperatures. It further contains several bacteriological instruments, such as an incubator, a hot-air sterilizer and a steam sterilizer. Along the walls stand a number of cases in which thermometers, hygrometers, pipettes, burettes, bottles and flasks of different kinds, staining materials, imbedding materials, slides, cover slips, double-wall jars (which can be filled with colored fluids so as to grow plants with colored light), disks, glass boxes, etc., are kept in stock. In this room a great number of chemical reagents, glass tubes, etc., are also kept. There is a small room adjoining, which is the professor's private room, and in which all delicate instruments are kept when not in use, *e. g.*, an auxanometer, a galvanometer, a klinostat, a chemical balance, microscopes, microtomes, polariscope, microspectroscope, a magic-lantern, etc.; also, a large collection of slides for the magic-lantern and several other things. Leaving the first mentioned room by another door, we come to a staircase which leads into the museum. The latter contains a large collection of models and specimens (both in spirit and dry). Perhaps I shall describe the museum more in detail in a future article; at present I will only mention that it is chiefly to serve as a place where the materials necessary for showing in lectures are kept, not as a place for the instruction of the public. Having passed this staircase, we see on the left hand side a small room which can be completely darkened. It is used for photographic purposes, but of course it can also be made available for growing plants, either in complete darkness or with colored light. The laboratory possesses a very good microphotographic apparatus by Zeiss. We now pass into the lecture-room. On the walls we notice, among other things which are hardly worth mentioning, Noll's apparatus for demonstrating the secondary growths of woody stems. There is nothing else in the front part of the room which attracts our attention, except, perhaps, a plain lecture table and benches for the students; but in the back part we see a large stand with glass dishes, etc. This is the same stand which the late Mr. Thomas Walton exhibited in 1886 at the Birmingham meeting of the British Association for the Advancement of Science for growing algæ and other organisms in sea water or fresh water. It is very ingeniously constructed, but its arrangement can not be clearly explained without diagrams. Owing to circumstances which could not be foreseen, it has not yet worked very well here; but it is expected that the present difficulties will soon be overcome. Opposite the stand there are a number of cases which contain a large collection of systematically arranged diagrams and drawings for use in lectures. Among them are the well-known diagrams by Kny and Dodel-Port.

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[1] Botanisches Centralbatt Bd. xxv, No. 16.

Entering now the other wing of the building, we first come into a small coat-room, and then we reach the morphological laboratory. This is a spacious room provided with large windows which are almost as high as the room itself. There is very little space left between them, so that they afford very good light. Unfortunately, they look toward the south, which is a great drawback, as blinds have to be used when the sun shines. The students occupy tables which form a row along the windows. These tables are quite plain and strongly built. I do not think that it is necessary to have any specially constructed desk for morphological botanical work, either microscopical or macroscopical. Each table is provided with two gas lamps, as usually two students work at one table. On each of them there is a stand on which bottles containing reagents can be placed in such a way that they are protected from the direct sunlight. The bottles used for reagents are those known as glass-capped bottles. As each of them has its separate glass rod, the reagents are always kept pure. This is a rather important point, often too little valued by beginners. The following is a list of reagents which every student preparing for the preliminary examination[2] receives: glycerine, Schultze's solution, solution of iodine in water (with KI), sulphuric acid, hydrochloric acid, acetic acid, potash, aniline sulphate (dissolved in dilute sulphuric acid), solution of phloroglucin, Kleinenberg's Hæmatoxylin, solution of iodine in pure water (the latter when required). Of course, more advanced students get everything that is necessary in modern microscopic technique. It may be mentioned here that boiling of tissues with Schultze's macerating fluid is always done in the small room which leads into the morphological laboratory. Besides these reagents, every student receives a bottle of methylated spirit, a bottle of distilled water, several small dishes and glass boxes, some blotting-paper, a dissecting microscope, a compound microscope and a moist chamber (the latter when required). He has to provide himself with slides, cover-slips, a good hollow-ground razor, a few scalpels, a pair of scissors, a few needles, a few camel-hair brushes of different sizes, a sketch-book and drawing implements. The practical teaching of the "preliminary men" is, on the whole, guided by "Bower and Vines' Practical Botany." A sufficient supply of material for these men is always kept in spirit, but fresh specimens are examined whenever this is required and the season is favorable. A collection of microscopical preparations illustrating Bower and Vines' book is kept in order to be shown whenever a student, after several attempts, fails to get a sufficiently good preparation himself. The middle part of the room is occupied by two large tables, which serve for various purposes at different times and are very useful. Along the rear wall there is a bench with several sinks for washing plants, bottles, etc., several warm chambers, imbedding apparatus, Bunsen burners, etc. Above these are several shelves on which a great many things frequently used are placed, such as jugs, dishes, bottles, a rough balance, a distilling apparatus, large bottles containing spirit, solutions of chromic acid and picric acid, common salt, distilled water, smaller bottles filled with potash, soda, several acids, alcohol of different strengths, Schultze's macerating fluid, etc. Along the other walls there are cupboards, in which a pretty large collection of systematically arranged materials for investigation, chiefly preserved in spirit, is kept. The material for the "preliminary men" is kept separate or arranged according to Bower and Vines' book. There are also a number of smaller cupboards, each with a separate key, in which the students keep their private property. In describing our laboratory I have endeavored to enumerate at the same time most things necessary for a botanical laboratory. In conclusion I may mention that anybody interested in the construction of a new laboratory will find much useful information in a book by E. C. Robins, entitled, "Technical School and College-Building." (London, 1887. Whittaker & Co.)

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[2] An examination which every student of science or medicine has to pass before entering into special studies.

Oxford, England.

Zygomorphy and its causes. III.

CHARLES ROBERTSON.

When shallow gamopetalous flowers become horizontal, they are subject to the same conditions as polypetalous flowers, and, like them, are apt to become sternotribe.

The flower of Campanula Americana[22] looks outward and a little downward, and would be regular but for the curvature of the style. The genus is actinomorphic, but this species is in the first stage of zygomorphy. Bees light upon the flower in such a way that the ventral surface of the abdomen strikes the pollen-bearing style in the male stage and the open stigma in the female stage. The style is bent down, so that the epigynous nectary is only accessible on the upper side. The uppermost flower of the spike commonly blooms before many of those below it. This flower often stands nearly erect and its style is nearly straight, so that it has much the same insect relations as in a terminal regular flower.

Deep gamopetalous flowers with exserted stamens and styles are also visited by insects lighting on these organs. They become sternotribe, access to the tube being on the upper side. In Lonicera one lobe forms the lower lip, while there are four in the upper, illustrating the tendency of sternotribe flowers to develop the attraction above the landing.

When a deep gamopetalous flower with included stamens and styles becomes horizontal, the convenient landing is on the lower side of the tube. The insect crawls back under the stamens and styles, so that these organs strike it on the back. The flower is, therefore, nototribe from the start, and it becomes advantageous for the organs to bend to the upper side of the flower and turn the anthers and stigmas so that they will strike the insect more effectually.

The lower nectary is most convenient, since it is in front of the landing. When the stamens and styles turn to the upper side of the flower, they make the lower nectary more convenient and the upper more inaccessible. A single nectary may be retained on the lower side, or an originally central nectary may become more strongly developed or only accessible on the lower side.

That these conditions in the insect relations have led to the production of nototribe flowers is supported by the fact that such flowers belong to gamopetalous orders, Scrophulariaceæ, Labiatæ, etc.

But some flowers belonging to these orders are sternotribe, such as Scrophularia.

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[22] For an account of the proterandry of this plant and figs. see Barnes, BOT. GAZ. X, 349, and pl. X, figs. 2 and 3. The flower is adapted to the larger bees, Apidæ. I have seen the following insects on the flowers: Hymenoptera—(a) *Apidæ;* (1) Bombus Virginicus Oliv. (mn); (2) B. separatus Cress (m); (3) B. Pennsylvanicus De Geer (n); (4) Apathus elatus Fabr. (m); (5) Melissodes bimaculata St. Farg. (mn); (6) Megachile brevis Say (f); all sucking as described above; (b) *Andrenidæ:* (7) Halictus sp. (f); (8) Augochlora pura Say (f); both collecting pollen; (9) Prosopis affinis Sm. (f); eating pollen. The Andrenidæ behaved dysteleologically, only visiting flowers in the male stage. (c) *Sphecidæ:* (10) Ammophila sp., trying to find nectar. Lepidoptera—(a) *Nymphalidæ:* Pyrameis cardui L., trying to find nectar.

Under S. nodosa H. Müller[23] says: "In most Lamiales and Personales the anthers lie in two pairs, one behind the other, and touch an insect visitor on the dorsal surface; the stigma then, to insure cross-fertilization, must also touch the insect on the back, and the style can scarcely lie elsewhere than between the two pairs of stamens, along the upper part of the corolla. The superior stamen comes in the way, and accordingly disappears; it has no chance of reappearing permanently, for it is directly injurious, and is weeded out by natural selection." * * "In Scrophularia, on the other hand, the anthers come in contact with the ventral surface of the insect. The fifth stamen is thus useless but not injurious; whether it be present or absent is of no importance, and it is therefore beyond the influence of natural selection. Accordingly, the small black scale-like appendage on the upper wall of the corolla in Scrophularia, which represents the fifth stamen, shows not unfrequently more or less complete reversion to its primitive form." It seems to me to be more consistent with the affinities of Scrophularia to suppose that the fifth stamen was aborted under the same conditions as in other didynamous flowers, and that the organs formerly occupied the upper side of the corolla. This will relieve us of the embarrassment of explaining the abortion of the fifth stamen under the influence of natural selection in most Scrophulariaceæ and "beyond the influence of natural selection" in Scrophularia. The antheriferous condition of the filament need not give us any trouble, but may rather confirm the supposition, since it is a plain indication that the conditions which led to the abortion of this stamen no longer exist to keep it reduced. I believe that the flower was originally adapted to bees, which squeezed into the tube, and that it has become shallow in adaptation to wasps. Increase of shallowness has had the effect of exposing the stamens, so that insects could light upon them, and they have therefore turned to the lower side. If the flower was originally shallow, and was visited by insects lighting on the stamens, I see no reason why the upper stamen should have been left behind.

There are other examples of sternotribe flowers belonging to nototribe types, but the reduction of the upper stamen in all, or most of them, is an indication that the organs were once crowded in the upper part of a narrow tube. There is generally no tendency to abortion of the stamens in sternotribe flowers, since, the flower being shallow, there is room for many stamens without crowding.

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[23] Fertilization of Flowers, 434.

We have observed that sternotribe flowers may become nototribe by inverting, and now it appears that nototribe flowers may become sternotribe by becoming shallow, or by having their stamens and styles exserted. An observation of H. Müller on the flower of Odontites serotina shows how it might be advantageous for the stamens to turn to the lower side of the flower, and may help us to understand the case of Scrophularia. He says:[24] "The upper lip, as the figure shows, projects so slightly that the anthers in great part protrude beyond it and are unprotected. This is sometimes the case to such a degree that bees thrust their tongues into the flower above the stamens and thus suck honey and shake out the pollen without leading to fertilization."

By reduction in size and close crowding, associated with an exsertion of the stamens and styles, some labiate flowers have lost the insect relations which I think have modified them. Like Amorpha, they are fertilized by insects crawling over the inflorescence. In this way Lophanthus[25] seems to have lost much of its labiate character.

In the foregoing it is claimed that the original visitors must have lighted on some part of the flower, and that the character of the irregularity depended on whether the place of lighting was below or upon the sexual organs. But some irregular flowers are specially adapted to humming-birds and hawk-moths, which suck without lighting.

The fact that most zygomorphous flowers are bee-flowers indicates the importance of bees as the principal visitors. The importance of bees in producing the modifications is even greater than is at present indicated by the flowers; for I think there is reason to believe that most, if not all, of these flowers which are not adapted to bees were originally modified by them and have been usurped by other visitors.

Humming-birds and hawk-moths fly so rapidly and suck so easily that it is not hard to understand how they might take possession of bee-flowers which suit their fancy. Flowers adapted to them vary in position from erect to pendulous, and they can suck all of these with equal convenience and without lighting. If they visit regular horizontal flowers, they are not influenced by any place of landing and can suck one nectary as conveniently as another, so that there is no advantage in the organs turning to any particular side. But zygomorphous flowers adapted to these kinds of visitors follow the same rule as those adapted to bees, *i. e.*, those of shallow origin are sternotribe and those of deep origin are nototribe. Therefore, I believe that they were originally adapted to bees which lighted on some part of the flower.

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[24] Fertilization of Flowers, 446.

[25] See Foerste on L. nepetoides, Am. Nat. XVIII, 928.

Many flowers adapted to humming-birds and Sphingidæ have a well developed landing which they could have had no influence in producing. This is shown by the fact that this part is sometimes much reduced in flowers adapted to them, as in Salvia splendens,[26] a bird-flower which belongs to a melittophilous genus. That birds have no influence in producing zygomorphous flowers is indicated by Lonicera sempervirens, which is more regular than the species visited by bees. Flowers originally modified by Sphingidæ are regular, like Datura, Convolvulus, etc.

Many flowers adapted to bees show butterflies, Sphingidæ and humming-birds as intruders, and this is important, since it enables us to understand how bee-flowers might become modified to suit them.

Linaria is a good example of a melittophilous genus. The broad tube is suited to bees, and the palate, which seems to be intended to exclude butterflies and flies, is easily opened by bees. H. Müller found L. vulgaris[27] visited exclusively by bees (8 species). In Illinois I found it visited by 5 species of bees and 4 species of butterflies. L. alpina, according to Müller,[28] is adapted to humble-bees, but is visited by Lepidoptera also. In Florida I found L. Canadensis visited by bees, but much more frequently by butterflies. The spur is very slender, and the tube has become so contracted that bees can only insert their tongues, and butterflies can not suck without touching the anthers and stigma. The palate seems to have lost its function, for it is so weak that it entirely fails to exclude butterflies or even flies. I have seen three flies sucking and eating pollen—*Toxophora amphitea*[29] Walk., *Mesograpta marginata* Say and *Baccha Babista* Walk. The color and other characters of this flower are melittophilous. yet it is modified to suit butterflies, which have become the predominant visitors.

Delphinium is adapted to bees, as far as observed. But Müller saw D. Consolida visited by butterflies, Hesperia and

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[26] See Trelease Am. Nat. XV, 265.

[27] Fertilization of Flowers, 432.

[28] Alpenblumen, 275.

[29] The flies mentioned in this paper were named by Dr. S. W. Williston.

Satyrus. I have seen D. tricorne visited by 6 species of bees and 7 species of butterflies. Here is a bee-flower in which the number of species of butterflies exceeds the number of bees. The spurs point upward more or less directly, so that, while bees have no difficulty in clinging to the flowers, butterflies, which prefer erect flowers, are put to considerable inconvenience, especially the Papilios, which generally suck with their wings in motion.

One cause of a change of visitors in flowers of shallow origin is probably the inversion of the flower. If the flower of Delphinium tricorne should become inverted, the bees, being thus deprived of their accustomed landing, could not suck the flowers so easily, while the butterflies could suck with more ease.

The views expressed above may be summed up in the following propositions:

1. When shallow flowers become horizontal, insects light on the stamens and styles and prefer the upper nectary.
2. The stamens and styles bend to the lower side, and the lower nectaries abort.
3. Zygomorphous flowers of shallow origin are sternotribe, and have a single nectary present, or a central nectary more strongly developed or more accessible, on the upper side.
4. Nototribe flowers of shallow origin are inverted.
5. When regular tubular flowers with included stamens and styles become horizontal, insects land on the lower border and prefer the lower nectary.
6. The stamens and styles bend to the upper side, and the upper nectaries abort.
7. Zygomorphous flowers of deep gamopetalous origin are nototribe and have a single nectary present, or a central nectary more strongly developed or only accessible, on the lower side.
8. Sternotribe flowers of deep gamopetalous origin have originally exserted stamens and styles (Lonicera), or have become shallow (Scrophularia).
9. Irregular flowers were modified with reference to a landing place,[30] and were modified through the influence of insects lighting upon them.

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[30] (2) Die Honigbehälter sind auf derjenigen Seite der Blume entweder nur vorhanden oder doch stärker entwickelt, auf welcher sich die Aufliegestelle (!) für die Insekten befindet.

(3) Die Staubgefässe wenden ihre Beutel mit den Oeffnungseiten der Aufliegestelle (!) der Insekten zu; daher im ganzen auch den Honigbehältern. Jordan, Stellung der Honigbehälter und der Befruchtungswerkzeuge in den Blumen, 54.

10. Irregular flowers adapted to insects which do not light have changed visitors.

11. Small, closely-crowded flowers do not tend to become zygomorphous.

12. Small, closely-crowded, irregular flowers are liable to lose their zygomorphous characters, unless the stamens and styles are protected by galeæ, carinæ, etc.

Carlinville, Ill.

Proceedings of the Botanical Club.

Wednesday, August 15, 1888.—The Botanical Club of the A. A. A. S. was called to order by the President, David F. Day, who spoke a few words of welcome and good cheer. Considering the time, the attendance was excellent. In the absence of the Secretary, Prof. V. M. Spalding, Rev. William M. Beauchamp was elected Secretary *pro tem.*

Mr. Thomas Meehan read a paper on the elasticity of the filaments in Compositæ. Mr. Meehan pointed out the elasticity of the filaments of a few Compositæ in 1883, and brought the matter before the Association in 1884, when some questions were raised whether it was not irritability rather than elasticity that caused the behavior.[1] He now adds that the filaments of a large number of Compositæ are elastic (Heliopsis exhibits it most clearly), and describes an observation upon Helianthus doronicoides which shows that it is not irritability.

Mr. W. H. Seaman followed with some remarks upon the variation of Azalea nudiflora in respect to odor and viscidity. This species, when growing in high latitudes and on mountains, is quite viscid and odorous, while in lower ground and more southerly stations it is smoother and nearly odorless.

Mrs. H. L. T. Walcott corroborated the observation in regard to the species about Medford, Mass.

Mr. Meehan read a second paper upon gyno-diœcious Labiatæ. He added to the already-known species Nepeta grandiflora, a native of the Caucasus, and pointed out the differences between the hermaphrodite and pistillate plants. In the former the heads of flowers are more numerous, but less fertile, the flowers are much larger and more loosely spicate and the internodes longer. Mr. Meehan thought the less fertility of the hermaphrodites due to lessened opportunities for the pistils to obtain nutrition rather than to defective pollination. The cause of the tendency to abort the stamens in many Labiatæ he thought scarcely identical with that which causes gyno-diœcism. Mr. Meehan's papers will appear in full in the Proceedings of the Philadelphia Academy. After discussion, the club adjourned.

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[1] See this Journal, vol. IX, p. 158.

THURSDAY, 9 A. M.—The club was called to order by the President. About thirty present. W. H. Hale, chairman of the committee appointed, made a report adverse to the formation of a botanical section. The report was adopted.

A letter was read from Mr. J. D. Rockefeller inviting the club to visit his grounds, which, being largely natural, might be of interest. As it was impossible to spare the time, the club instructed the Secretary to express their thanks for the kind invitation and regrets that they were unable to accept it.

Mr. Meehan moved the appointment of a committee to draft resolutions on the death of Dr. Asa Gray. The chair appointed Messrs. Meehan, Barnes and Kellicott.

Mr. Beauchamp called the attention of the club to living specimens of Erythræa Centaurium which he had brought for the use of the members from the original station at Oswego, N. Y. He then read a paper upon the Onondaga (Indian) names for plants, in which he enumerated the names of the chief plants known to these Indians, and gave their signification.

Mr. Meehan spoke on the tendency to irregularity in the tubifloral Compositæ. In Silphium perfoliatum and many other Compositæ two of the five lobes of the corolla are approximated to form an "upper lip," and three to form a "lower lip." The gynœcium is also frequently involved in this irregularity, and instead of being straight bends against the lower lip even when to do so it has to oppose the action of gravitation.

Dr. E. L. Sturtevant exhibited a large series of water-color drawings to illustrate the variability of the fruit of wild and cultivated species of Capsicum, a genus which he thinks contains but a few species, instead of the many which have been described.

Mr. B. E. Fernow endeavored to answer the question, "What is a tree?" by proposing a definition for the term. After showing the looseness of present definitions and the need of greater precision in the use of the word, he defined trees as woody plants, the seed of which has the inherent capacity of producing naturally within their native limits one main erect axis not divided near the ground, the primary axis continuing to grow for a number of years more vigorously than the lateral axes, and the lower branches dying off in time.

The definition was objected to, and a lively discussion ensued, participated in by several members of the club. which the last speaker summed up by saying that we should still have shrubby trees and arborescent shrubs.

FRIDAY, 9 A. M.—The club met in the hall of general sessions. Upon motion, the President appointed as a committee to nominate officers for the ensuing year Messrs. Scribner. Barnes and Meehan. The committee to draft resolutions upon the death of Dr. Asa Gray reported the following, which were adopted by a unanimous rising vote:

Resolved, That the Botanical Club of the American Association for the Advancement of Science sincerely regrets that, meeting as it does but once a year, it should be among the last of similar associations to place on record its sense of the great loss which the whole world of science suffers by the death of Prof. Asa Gray.

Resolved, That, though among the last to contribute to the wreath of sorrow with which science everywhere is crowning the memory of Dr. Gray, this body takes a mournful pride in remembering that he was one of its honored members, and that it was as a botanist he won such eminent renown. We feel that we have a right to be among the chief of mourners at his departure from the field of labor he loved so well, and in a special degree to unite in sympathy with the many thousands who miss him everywhere.

Resolved, That copies of these resolutions be forwarded to the family of our deceased friend, and given to the botanical and other scientific journals for publication.

THOMAS MEEHAN,
C. R. BARNES,
D. S. KELLICOTT.

A paper by Dr. Geo. Vasey upon the "Characteristic Vegetation of the North American Desert" was read by Mr. Tracy, and illustrated by a number of lantern views of plants exhibited by Dr. E. P. Howland. This paper will appear in full in the GAZETTE.

Mr. C. R. Barnes spoke on the acridity of Arisæma triphyllum. Following up a suggestion in a note by Stahl in the *Biologisches Centralblatt* (see this journal, p. 24), experiments were made to determine whether the acridity of the expressed juice of the corm could be removed by filtering out the raphides. After one filtration the acridity was almost lost, while upon a second filtration the juice was entirely bland. It would seem likely, therefore, that the intense burning sensation was due to the penetration of the mucous membrane of the mouth by the raphides, though this has not yet been crucially tested.

Mr. Lazenby mentioned the fact that the corm of Calla was less acrid than the petioles, and that it contained smaller quantities of crystals.

Mr. A. A. Crozier sent a paper on the secondary effects of cross-fertilization, which was read by Mr. Cowell. He had crossed many varieties of apples and other fruits to determine whether any effect appeared in the fruit of the first year, but his experiments led to the belief that it did not.

Mr. Cowell dissented from this view as contrary to his experience.

Mrs. Henrietta L. T. Walcott described and exhibited specimens of an amber-fruited choke-cherry, collected in Dedham, Mass. The chief differences are in the somewhat broader leaves, three or four times shorter and more compact racemes, and the amber-colored fruit. Dr. Sereno Watson proposes for it the varietal name *leucocarpa.*

Mr. W. R. Lazenby exhibited the two forms of Ampelopsis, one of which adheres to brick or stone walls, trees, etc., by means of the disk-like expansion on the tendrils, and the other of which will *not* climb walls and forms no disks. The latter is the only one sold by nurserymen, and much disappointment ensues from its failure to clamber over walls.

Mr. Beauchamp disagreed with Mr. Lazenby, and thought the tendrils were modified to suit circumstances.

Dr. Campbell suggested that the nursery plants were A. hederacea of Europe, and not A. Virginiana.

On Friday afternoon at 2 o'clock about forty members of the club boarded a special Brooklyn-line car, and, after a pleasant ride across the city, alighted at Brighton, where a few minutes' walk took them into a wild glen, with numerous side ravines cutting into it. The region was not specially remarkable botanically, but served to give a fair idea of the August flora of the country. Jeffersonia diphylla was collected in fruit, and proved to be a rarity to eastern botanists. The mycologists gathered the richest collection, but all brought in some plants of interest. At 5:30 the car was found awaiting the party, and an hour's ride brought them again to their lodgings. These short excursions are among the pleasantest features of the Association, and serve to promote the friendly intercourse which is perhaps as important and beneficial as the information gained. The club feel under special obligations to the local botanists who perfected the arrangements and did so much to make the trip pleasant.

MONDAY, 9 A. M.—The club was called to order by Dr. W. J. Beal, in the absence of the President.

Mr. Joseph F. James exhibited a series of forms of Dentaria laciniata and D. multifida, and held that the latter should be considered as a variety of the former. He also showed an abnormal form of Asclepias tuberosa with flexuous stem and sub-opposite leaves, which he thought entitled to the varietal name, *flexuosa*.

Mr. F. L. Scribner gave some observations on nomenclature. He read an extract from a letter of Dr. Hackel (see page 243) on the citation of authorities. He stated the objects of citation to be two, viz., to fix the species meant and to furnish a clew to the literature. The following case was cited: Pursh described Stipa membranacea; Thurber, ignorant (as almost every one was) of Pursh's name, called it Eriocoma cuspidata; it turns out to be an Oryzopsis; ought Scribner to go back to Pursh's specific name, *membranacea*, or is he right in calling it *Oryzopsis cuspidata* Scrib.?

The general topic awakened discussion. Mr. Barnes contended for the indivisibility of a plant name and the citation in lists, etc., of a single author after it, without any intention of "giving credit."

Mr. James and Mr. Beauchamp thought the author of the specific name ought to be cited in parenthesis, a proceeding the uselessness of which either for reference or "credit" was pointed out by Mr. Scribner.

Mr. F. L. Scribner also read a paper on Sphærella Fragariæ, the strawberry leaf-blight. As a justification for the formation of the common name, he stated the principle adopted by the section of vegetable pathology. The diseases or injuries caused by Ramularia, Cercospora, etc., are called "blight;" those caused by Uredineæ are "rust;" those due to Phyllosticta, Septoria, etc., are "leaf-spot." The author enumerated and remarked on the fungi thought to represent the stylosporic form of Sphærella. He has found the spermagonial stage, he believes, which is quite distinct from Septoria aciculosa. We therefore know all three stages of the Sphærella.

Mr. Meehan spoke on the functions of the peduncular bract of Tilia. He thinks it is, among other things, for the purpose of holding up the peduncle so the flowers will not hang too close together, and also to bring them under the leaves so that bees can work at them in wet weather.

Mr. D. H. Campbell spoke of the germination of Marsilia Ægyptiaca. Of spores from herbarium specimens eleven years old, fifty per cent. germinated, and of those five years old, almost all grew. From 10–12 hours suffices for the germination and complete formation of male and female prothallium.

The committee for nominating officers for the ensuing year reported, naming for President, T. J. Burrill, of Champaign, Ill.; for Secretary and Treasurer, D. H. Campbell, of Detroit. They also recommended the establishment of the office of Vice-President, and nominated B. D. Halsted, of Ames, Iowa. The report was adopted and the officers elected.

Dr. Vasey sent to the club a report of progress of the Botanical Exchange Club. (See p. 240.)

TUESDAY, 9 A. M.—W. R. Lazenby spoke of the flora of Ohio, referring chiefly to that of Franklin county, which showed 714 Phanerogams, and not a single Ericad.

F. L. Scribner made some remarks concerning Andropogoneæ, referring to Hackel's forthcoming work. [This paper will be published later in the GAZETTE, together with citations of herbarium numbers, so as to make it immediately available to American botanists.—EDS.]

Changes in host plants, induced by Puccinia graminis, were discussed in a paper sent by V. M. Spalding. The leaf where affected is three times as thick as elsewhere. In wheat the epidermal cells are often enlarged and ruptured. Contents of cells show chlorophyll bodies decomposed. He referred also to the changes in the grain.

M. B. Waite spoke of changes in the fungus flora near Champaign, Ill.

W. J. Beal gave an account of the flowering plants of Northern Michigan.

Abstracts of the botanical papers read before section F of the A. A. A. S., at the 37th meeting, Cleveland, Aug. 15–22, 1888.

A plea for uniformity in biological nomenclature: by N. L. BRITTON.

The paper cites the discrepancies in the application of the law of priority in the binomial and trinomial citation of organisms and urges a method to secure uniformity.

[Dr. Britton is absent in England, and his paper did not reach the section. As only the above extract was read, there was no discussion.]

A study of Hydrangea as to the objects of cross-fertilization: by THOS. MEEHAN.

The author detailed a number of facts connected with the structure and development of allied species of Hydrangea, and argued that on no theory of evolution based on adaptation to insect visits could these changes occur. He contended that variety must exist in order to provide for order, and that variations, as we see in Hydrangea, can be of no special benefit to the plant, but exist for mere variety's sake.

A phase of evolution: by E. LEWIS STURTEVANT.

Botanical varieties are the unit of evolutionary progress under vegetable culture, as evidenced by a study of cultivated and wild dandelion. Colored drawings and herbarium specimens were exhibited demonstrating the substantial identity of garden varieties with wild varieties, and, conversely, showing the types for new future varieties.

[Discussed by Messrs. Campbell, Tracy, Riley, Lazenby and Meehan.]

Notes on the inflorescence of Callitriche: by JOS. SCHRENK.

The bracts of the inflorescence, which Caspary calls stipules and Schenk calls trichomes, the author finds to be bladders filled with air and with walls of a single layer of cells. The cavity of these organs is schizogenous and they are equivalent to phyllomes. Their purpose is to give necessary buoyancy to the apex of the stem. A study of the histology of the flower-cluster makes the author believe that the stamen and pistil constitute one flower, so that it is not monœcious, as described, but perfect.

[In the absence of the author, the paper was read by the Secretary. No discussion.]

Hygroscopic movements in the cone-scales of Abietineæ: by ALBERT N. PRENTISS.

In most of the Abietineæ, soon after the maturation of the cones, the persistent scales fold backward or outward from the axis to permit the ripened seeds to escape. The scales are very sensitive to moisture, and in many species exhibit very rapid movements when wet, as with rain. This is especially well seen in the cones of Tsuga Canadensis, in which the widely-open scales become completely closed in twelve minutes. This property of the cone-scale is found to be very efficient, first, in loosening the winged seeds from the scale which bears them, and second, in favoring the wide dispersion of the seeds, as the cones open and close many times before all the seeds are sown, thus securing their transport in different directions by the varying winds.

[The above abstract was read by the Secretary. No discussion.]

Some new facts in the life-history of Yucca and the Yucca moth: by THOS. MEEHAN.

The author gave some figures in regard to the time of opening and the duration of the flowers, with notes on the time and duration of the moisture exudation from the perianth. The cause of the sudden stoppage of the waste was discussed, and some remarkable facts in connection with Pronuba yuccasella, observed by Dr. Riley, confirmed. The remarkable adaptation by which an insect is made to do the work of self-fertilization which the plant could just as well do for itself was contrasted with similar observations in the animal kingdom.

[At the suggestion of Mr. Barnes, the President of the section, Dr. Riley, replied to the paper. He restated the facts, which had been demonstrated conclusively, that Yucca was incapable of self-fertilization, and that Pronuba cross-fertilizes the flowers and oviposits in the pod. He cited Trelease's observations on the nectary, showing that the moth gets no reward in nectar for this work. He characterized Mr. Meehan's conclusions as totally unjustifiable. Mr. Day remarked that his plants of Yucca were self-sterile, and he had no hesitation in saying that they were functionally diœcious.]

On the cause and significance of dichogamy in flowers: by THOS. MEEHAN.

The author repeated the announcement of his discovery, made first through the *Proc. Phil. Acad.*, that it takes a longer-continued amount of heat to excite growth in the female than in the male organs of flowers, and that varying seasons will therefore advance or retard the several sexual organs accordingly. Therefore, there is absolutely nothing in connection with the visits of insects to account for dichogamy, which is solely an accident of climatic environment.

[In the discussion which followed, Messrs. Day, Fernow and Barnes wholly dissented from the conclusions reached by the author.]

Adaptation in the honeysuckle and insect visitors: by THOS. MEEHAN.

The author gave all the points in the flowers of certain honeysuckles, and the development of the extraordinary amount of nectar from which the plant derives its common name, and showed that the insects which visit the flower for the sweet secretions take no part in the pollination of the flower. This office is performed by pollen-gathering insects for which no special adaptation has been made, and which rather aid self- than cross-fertilization.

[Discussed by Messrs. Tracy, Day, Lazenby, Campbell, Burrill, Barnes, Sturtevant and Riley, most of whom disagreed with the deductions of the author.]

Systematic position of the Rhizocarpeæ: by DOUGLAS H. CAMPBELL.

The paper gave an account of the author's studies in the embryology of Pillularia and allied forms, which show the Rhizocarpeæ to be more nearly related to true ferns than heretofore supposed. The more intimate researches were carried on by means of paraffin imbedding and serial sections. The older literature was cited, and much shown to be erroneous on account of unsuitable methods.

[The work was commended by Messrs. Barnes and Burrill.]

Pollen germination and pollen measurement: by BYRON D. HALSTED.

I. The author, in studying the germination, sought to improve upon the methods, and after considerable trial adopted for holding culture liquid the artists' well-slabs, containing as large a number of wells as possible of such size that they can be covered with thin glass. The advantages are obvious in the comparison of various sorts of pollen under the same conditions or of the same sort in various solutions.

II. The second part of the paper gave measurements of various pollens, both moist and dry.

[No discussion.]

Comparison of the Flora of eastern and western Michigan in the latitude of 44° 40′: by W. J. BEAL.

The paper describes the climate and topography of the lake shores in the locality named. The following northern plants were found on the east side of the state, and not on the west side:

Ribes lacustre Poir.
Kalmia angustifolia L.
Kalmia glauca Ait.
Dracocephalum parviflorum Nutt.
Picea alba Link.
Sparganium simplex Hudson.
Carex Backii Boott.
Carex sterilis Willd.
Carex capillaris L.
Carex Houghtonii Torr.
Botrychium Lunaria Swartz.
Botrychium simplex Hitchcock.

The following southern plants were found on the west side and not on the east:

Acer dasycarpum Ehrh.
Rubus occidentalis L.
Sambucus Canadensis L.
Sassafras officinale Nees.
Ulmus fulva Michx.
Ulmus racemosa Thomas.
Adiantum pedatum L.

These lists, so far as they go, support the prevailing belief that the west side of the state has the milder climate, a view based upon the fact that tender fruits thrive better on the west than on the east.

[No discussion.]

Observations on the succession of forests in northern Michigan: by W. J. BEAL.

After referring to various unsatisfactory and unscientific theories as to the cause of the change in the character of a forest when a "second growth" appears after clearing or burning of the virgin forest, the author gives an account of his observations in various localities in Michigan. In a virgin forest there are, in addition to the Coniferæ, scattering trees of maples, oaks, ash, aspen and various shrubs and deep-rooted perennial herbs. The young deciduous trees are small and spindling, and almost always come from clustered roots called "grubs," showing that the present growth is not the original sprout, but the second, third or fourth from the same root. Often smaller plants, only a few inches high and less than an eighth of an inch in diameter, are found, which show by the bud-scale scars that they are four to ten years old. It is not difficult to find oaks under eighteen inches high that are twenty or more years old, and, as the present may be the third or fourth sprout, it is not improbable that the root is sixty to one hundred years old. All the deciduous trees named show the same mode of growth, while the young hemlocks and pines do not behave so. On examining "stump lands" which had just been burned over, abundant shoots of the deciduous trees named were found coming up from the stumps or roots, but no pines or hemlocks. Older stump lands show the same facts, the young deciduous trees, however, being larger.

On "jack-pine plains," where the second growth is still predominantly the jack-pine, seventy-two species of plants are quite uniformly observed, of which sixty-eight are perennials, including among trees two aspens, three oaks and one pine, with occasionally two other pines. Of the trees, the oaks survive fires in the way above indicated, the aspen seeds are easily blown in by the wind, and seeds of the occasional pines come from neighboring territory. Pinus Banksiana, however, is specially adapted to seed itself in the same place by the persistent closure of the cones, which are borne even by very young (five-year old) trees. Only unusually dry weather, the death of the tree or the heat from a fire will cause the scales to open and allow the seeds to escape. Of seeds 2–4 years old, 95 per cent. germinated; from 4–6 years old, 85 per cent.

Thus, when the second growth is different from the first, it is explained by the persistence of the deciduous trees already present or the introduction of new species in the ordinary course of seed-distribution. When it is not different it is because the species of pine is specially adapted to reëstablishing itself.

[After a few questions, further discussion of the paper was postponed until Monday morning, when Mr. Fernow wished to speak upon it. He was called away suddenly, however, and the discussion was not resumed.]

Discovery of the production of immunity from contagious diseases produced by chemical substances formed during bacterial multiplication: by D. E. SALMON.

The author discussed and answered objections to this theory of immunity, which was presented to the Association in 1886. MM. Duclaux, Roux and Chamberland endeavor to minimize his discovery and claim priority, though their work is more recent. The early experiments were defended and their demonstrative character shown. The author, therefore, continues to claim priority.

[No discussion.]

BRIEFER ARTICLES.

The Botanical Exchange Club.—As there is no regular committee to report on the Exchange Club, and as that club owes an account of itself to its parent, the Botanical Club of the A. A. A. S., the following informal report has been prepared:

At one of the sessions of the club held during the New York meeting of the A. A. A. S., the Rev. Thomas Morong suggested that a botanical exchange club, similiar to those existing in Europe, be formed in this country. The suggestion met with the hearty approval of many members of the club. A committee, consisting of Dr. George Vasey, Dr. Sereno Watson, Dr. N. L. Britton, Rev. Thomas Morong and Prof. Byron D. Halsted, was appointed with power to act for the club, and to report through the botanical magazines. The committee published, first in the GAZETTE, and in the *Bulletin* for February of this year, a preliminary outline for the organization of the Exchange, based on the rules of the Botanical Exchange Club of the British Isles, and asked for suggestions and improvements for a permanent constitution. A few months later the committee published a note announcing the location of the head-quarters of the Exchange at the National Herbarium, in the Department of Agriculture at Washington, and soon after the final report of the committee came out in the June number of the botanical magazines in the form of the governing rules of the Exchange.

As at present constituted, then, the Botanical Exchange Club consists of a number of persons organized for the purpose of exchanging botanical specimens, and governed by certain rules. The correspondence, finances and general management of the Exchange are in the hands of a director. A considerable number have already become members, and packages of specimens are beginning to come in. With the increased membership and contributions that the Exchange will have by the end of this season's botanizing, the director can soon put the exchanging into full active operation.

Printed copies of the rules will be distributed, and an opportunity will be given to any of the botanists present to become members of the Exchange. The annual fee of two dollars has been set for the purpose of paying the expenses of printing, transportation of specimens and correspondence.

All packages and correspondence should be addressed to Dr. George Vasey, Director of the Botanical Exchange Club, Department of Agriculture, Washington, D. C.

A list of new mosses of N. Am.—The descriptions and drawings of the following mosses, by F. Renauld and J. Cardot, will be issued shortly in the BOTANICAL GAZETTE:

Microbryum Flœrkeanum Sch. var. *Henrici.*—Kansas (Henry).

Weisia viridula Brid. var. *nitida.*—Louisiana (Langlois).

Dicranum hyperboreum C. Müll. var. *papillosum.*—Greenland.

Dicranum sabuletorum (*D. spurium* var. *condensatum* Lesq. et James, non *D. condensatum* Hedw.). Southern States.

Dicranum scoparium Hedw. var. *sulcatum.*—Miquelon (Delamare).

Dicranum Howellii.—Oregon (Howell).

Dicranum Miquelonense.—Miquelon (Delamare).

Fissidens incurvus Schw. var. *brevifolius.*—Louisiana (Langlois).

Trichodon (?) *flexifolius.*—Florida (Sawyer).

Physcomitrium pyriforme Brid. var. *Langloisii.*—Louisiana (Langlois). New Jersey (Green).

Bryum Sawyeri.—Florida (Sawyer).

Fontinalis Oregonensis (sub-species of *F. antipyretica*). Oregon (Howell).

Alsia Californica Sull. var. *flagellifera.*—California (Miss Mann).

Eurhynchium strigosum B. S. var. *Barnesii.*—Idaho (Leiberg).

Plagiothecium denticulatum B. S. var. *microcarpum.*—Idaho (Leiberg).

Amblystegium riparium B. S. var. *serratum.*—Kansas (Henry).

Amblystegium riparium var. *Floridanum.*—Florida (Garber). Louisiana (Langlois).

Hypnum symmetricum (sub-species of *H. uncinatum*).—Idaho (Leiberg). Oregon (Howell).

Hypnum arcuatum Lindb. var. *Americanum.*—Louisiana (Langlois).

Silk seeking pollen.—Director Speer, of the Iowa experiment station, is making some interesting experiments on the fertilization of corn. It is found that the silk will remain green and in a receptive condition and grow in length for a long time if not fertilized. Some silks just measured which have been out nineteen days, but covered to prevent fertilization, are sixteen inches beyond the ear. In one instance a few silks were fertilized the second day after they appeared, and six days later the remainder, two sizes of kernels appearing on the ear. In another case the ear was covered until the silk was well started and then pollenized. Twelve days later it was examined and found to have set almost perfectly, but the kernels toward the base of the ear were the smallest, showing that the longest silks required the most time for fertilization. In ordinary cases the silks from the base of the ear appear much the soonest and the lower kernels become fertilized first. In another case where the outer (lower) silks were cut off and the whole left exposed a greater difference in size between the top and butt kernels appeared. Silks were repeatedly cut off and the ear afterward successfully fertilized, proving that it is not the forked apex of the silk alone that is receptive. A. A. CROZIER, *Ames, Iowa.*

EDITORIAL.

ANOTHER PROPOSITION was made and considered this year to erect the Botanical Club of the A. A. A. S. into a section, or at least a sub-section. Fortunately, we think, the committee reported adversely to the proposition, after consulting the council and those who have had some experience with similar movements in other sections. We hope that this endeavor will not be renewed. It tends, even when unsuccessful, to exaggerate the importance of the club, and to that extent to interfere with its usefulness.

ANOTHER PROPOSAL which we think would be equally harmful should it be acceded to was that the club request the council to publish its proceedings in the regular volume. The Botanical Club should hardly be formal enough to be said to have "proceedings." It is to be the place where the short and less important observations can be set before our fellows; where the progress of investigations can be stated and coöperation asked; where movements for the benefit of botanists (such as the Exchange Club) can be initiated; where the botanists can meet informally and become better acquainted. Such were the objects of its founders, and these features it should be our endeavor to preserve. Any attempt to dignify it by adding formalities or limiting its freedom of speech would only ruin it.

As it is, there is a growing tendency to encroach upon the biological section. The sectional committee this year followed the precedent of the past two years, and arranged the programme so that all the botanical papers were read in the morning, and all the zoological in the afternoon. This year the "cutting" of zoological papers by the botanists was more marked than ever. Hardly a corporal's guard was present in the afternoon. The zoologists. who largely attended in the morning, complained of the desertion, and with justice. We are quite convinced—the conviction has been growing for two years—that the programme should be once more arranged so as to intersperse the papers. Not that botanists should be made to listen to what they don't want to hear, but they should not be invited to desert the section, for they are likely to hear a zoological paper which will be quite as instructive and suggestive as a botanical one.

We are quite unable to account for the fact that in general the Botanical Club was better attended this year than the biological section. The zoölogists were in the minority, both in number of members and number of papers. Very little can be claimed, however, for the quality of the botanical papers. With some exceptions, they showed a narrowness of observation and a superficiality of study which were lamentable. If we may assume the hortative, do let us broaden our conceptions of investigation, and when a subject is undertaken, look it from all sides, study its literature, and bring our observations and experiments to bear upon it in such a way that we reach not *a* conclusion, but *the* conclusion, and the *only* conclusion. If we do not narrow it to *that* point we lose all, and have merely our trouble for our pains.

OPEN LETTERS.

Prof. E. Hackel, on the citation of authors.[1]

If Mr. Bentham proposes the reduction of a genus to a section of another without giving a complete list of the changes in nomenclature which results from that alteration, *he is not considered* the author of any combination of names which is made by other persons adopting the reductions. For instance, Triodia acuminata, ambigua, mutica, stricta, Texana, etc., are no names of Bentham's, because you can never quote a page of his works where these names are to be found.

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[1] Extract from a letter addressed to Dr. George Vasey, October, 1883.

On the other hand, are you sure that Mr. Bentham, if examining all the species named above, would maintain them all with the rank of species? Possibly, yes; but you can assert nothing, and therefore you can not attribute such names as Triodia Texana to him. * * *

As matters now are we must quote *Triodia Texana* Vasey in "The Grasses," etc., etc. The botanist who seeks this name in your book finds the indication "*Tricuspis Texana* Thurb.," and now he is at a loss where to find more information about that species. The author of Triodia mutica is F. L. Scrib. in Bull. Torr. Bot. Club X, p. 30. He is also the author of Hilaria rigida (in Bull. Torr. Bot. Club IX, p. 86), not Bentham, who, in Notes on Gram., p. 62, mentions only H. cenchroides, H. Jamesii, H. mutica, H. sericea, as congeners.

It is true that it is no merit to change a name if another has given the reasons for changing it, but the quotation of any name of author behind a combination of names *expresses or proposes no acknowledgment of merit* at all, but serves only to guide the botanist in his search for information about the species. This is the principle recognized by most European botanists, and it implies the other principle that the quotation of the book where to find information is more important than that of the author of the name.

Concerning nomenclature.

I was much surprised when I read in the BOTANICAL GAZETTE (June, 1888, p. 161): "Shall the law of priority apply only to the combined generic and specific name, or to the specific appellation as well?"

If I understand it means a doubt as regards the fixity of a specific name when a species is transferred to another genus.

This point has been clearly considered and settled in the 57th article of our *Laws of Nomendature*, recommended by the Botanical Congress held at Paris in August, 1867[1]:

"When a species is moved into another genus the specific name is maintained, unless there arises one of the obstacles mentioned in the articles 62 and 63." (If the name exists already in the genus or could lead to some misconception.)

This rule is in conformity with the general principle not to change names without absolute necessity. It has also an advantage, which is to help remembering a species formerly in another genus.

We follow that rule in several cases more or less analogous to our scientific nomenclature. When Mexican cities have been transferred to the United States their names were not changed; when the name of a city is changed, those of the streets are kept; and if *John* Brown discovers that his real family name is Smith, he would be *John* Smith.

Allow me to recall that our *rules* were first submitted to a committee of eminent botanists of five different nationalities, afterward discussed in three sittings by more than a hundred members, and finally adopted by universal consent. Since that time I never heard any objection to the fixity of specific names, and if new names are given that are not necessary I would consider them as null.

Geneva, Switzerland. ALPH. DE CANDOLLE.

Polygamous flowers in the watermelon.

One of the characters given for Cucurbitaceæ is "flowers monœcious or diœcious." In making some crosses to-day on the Volga watermelon,

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[1] Translated in English. Reeves & Co., London. 1868.

a variety from southern Russia, I discovered that the so-called pistillate flowers possessed stamens. One hundred flowers were examined, and there were stamens in all. In seventy-six cases the stamens were three, the same as in the staminate flowers, which were present in about the usual number. In the others the stamens ranged from one to five. Where five were present they alternated with the five petals, and with the five parts of the pistil in such cases. Of the three stamens usually found, one stood alternate with the petals and the other two opposite to them, each of the latter showing by its position and larger size that it represented two.
A. A. CROZIER.

Ames, Iowa.

CURRENT LITERATURE.

A host-index of fungi.

Those who are acquainted with the Cryptogamic herbarium of Harvard University know what voluminous indexes are kept up to facilitate study of that splendid collection. In publishing an index to the hosts of parasitic fungi[1] the director and curator of the herbarium have placed at the disposal of students of fungi a most important help, one which will not only prevent the duplication of much drudgery, but will also greatly facilitate a more *accurate* study of the mycologic flora, and, therefore, "tend to lessen the amount of indiscriminate species-making, which has already become a serious evil." The index consists of a list of host plants arranged in the usual order, and in nomenclature following generally Watson's index. These names are printed in bold-face type, and followed by the names of fungi occurring upon them. Synonyms are but sparingly given, usually only those which have appeared in connection with the record of the occurrence of the species on particular hosts in N. A.

It is needless to dwell upon the utility of this publication. It commends itself at first thought to mycologists. The typography and arrangement are excellent. The authors expect to complete the work during the coming winter. Copies can be obtained for $1, by addressing either of the authors, at Cambridge, Mass.

The plant cell.

It is a little over twenty years since Hofmeister's "Lehre von der Pflanzenzelle" appeared, and in those twenty years a vast advance has been made in our knowledge of the finer structure of the plant cell by means of the improved optical appliances, and particularly the methods of investigation. As no work has appeared since the classical treatise of Hofmeister which gives in compact form a statement of the knowledge we possess about the plant cell, this book[2] of Dr. Zimmermann is specially welcome. It forms a part of Schenk's Hand-book of Botany, parts of which have already been noticed in this journal (vol. x. 314 and 331). So vast has become the literature of this subject that it has been quite impossible for Dr. Zimmermann to test all the observations recorded, but he has evidently used great care in quoting results, and has gathered from many sources. In a bibliography, "which lays no claim to completeness," 376 separate papers and works are cited. Botanists would thank the author had he done nothing more than summarize the chief points contained in these widely scattered papers; how much more do they owe him for the painstaking sifting and digesting which he has performed. The judicial remarks upon various opinions and theories seem to indicate a wise conservatism and the application of sound common sense to the intricate problems presented by the plant cell.

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[1] FARLOW, W. G. and SEYMOUR, A. B.—A provisional host index of the fungi of the U. S.—Part I—Polypetalæ, pp. 52, sq. roy. 8vo. Cambridge: [the authors] August, 1888.

[2] ZIMMERMANN, A.—Die Morphologie und Physiologie der Pflanzenzelle. (Sep.-Abdr. aus der Encyklopädie der Naturwissenschaften: Abtheilung, Handbuch d. Botanik.) pp. 223, figg. 36, roy. 8vo. Breslau: Edward Trewendt. 1887.

It is quite impossible to review this excellent work in detail in the space at command. We can serve our readers better by giving an insight into the scope of the work by citing the chapter headings. The first part (166 pages) treats of the morphology of the cell under the following main topics: Form of the plasma; intimate structure and chemical composition of the cytoplasm; the nucleus, its intimate structure and the chemical composition of the resting nucleus, nuclear division and coalescence; the chromatophores, their finer structure, chemical composition, inclusions, multiplication and metamorphoses; other organs of the plasma (such as cilia, eye-spots, etc.); proteid grains and crystalloids; starch grains and similar bodies; the solid and liquid inclusions of the cell; chemical composition, form, finer structure, origin and growth of the cell-membrane; cell-formation and growth.

The second part (40 pp.) treats the physiology of the cell under the heads: theory of swelling and osmose; physical properties of the cell-membrane; the hygroscopic parts of plants; physical properties of the plasma; aggregation; and the mechanics of the cell.

We venture to predict that this work will become as indispensable to students as Hofmeister's has been. American botanists especially will appreciate it the more because of the inaccessibility of most of the literature.

Minor Notices.

THE SEVENTH PART of Husnot's Muscologia Gallica[3] has been issued. It concludes the genus Orthotrichum, to which a key to species is given, and treats the genera Encalypta, Schistostega, Œdipodium, Dissodon, Tayloria, Tetraplodon, Splachnum. Ephemerum, Physcomitrella, Discelium, Pyramidula, Physcomitrium, Entosthodon, Funaria, Mielichhoferia, Orthodontium, Leptobryum, Anomobryum and Plagiobryum. Bryologists will notice the new association of the genera. The plates of this valuable work grow better and better.

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[3] HUSNOT TH.—Muscologia Gallica: Descriptions et figures des mousses de France et des contrées voisines. 7è livraison. pp. 193-224. pl. liii-lx. roy. 8vo. Cahan: the author. 1888. 5 francs.

The commissioners of the state reservation at Niagara requested Mr. David F. Day, the well known botanist of Buffalo, to prepare a list of the flora of the vicinity of the falls. This list[4] comprises 909 species. Common names and remarks on the localities and relative abundance are given. From Mr. Day's reputation for painstaking accuracy, we are sure that the catalogue may be depended upon.

The first bulletin[5] of the division of pomology of the Department of Agriculture relates wholly to fruits which can only be cultivated in the Southern States or California. Two Japanese plums and three varieties of Japanese persimmons are figured in colors, and certainly look tempting enough. The remainder of the report gives accounts of the growing of various tropical and semi-tropical fruits which are either now cultivated or might prove profitable in the localities named. The number is surprisingly large.

NOTES AND NEWS.

Dr. Douglas H. Campbell has been elected to the chair of botany in the State University of Indiana.

In the description of Polytrichum Ohioense, in the August Gazette, p. 200, Crowdin Mount, N. C., should read Crowder's Mount.

The professorship of botany at Bryn Mawr College has been consolidated with that of biology, under the charge of Dr. E. B. Wilson. We are sorry to record this backward step.

The Botanical Club, A. A. A. S., registered nearly sixty at Cleveland. So great has been the exodus to Europe this summer that that number may be looked upon as large. The absence of botanists from east of the Hudson was conspicuous.

Mr. B. T. Galloway, at present assistant in the section of vegetable pathology of the Department of Agriculture, will become the head of the section when Mr. Scribner assumes his duties at the University of Tennessee. The change will occur in October.

Dr. Delamare, whose work in connection with the Flora of Miquelon was noticed in this journal for June (p. 168), died recently at Miquelon, as we learn from M. Jules Cardot. Dr. Delamare was an indefatigable collector, and had almost completed his botanical exploration of the island.

Werminski gives[1] a brief account of his researches upon the nature of aleurone grains. He concludes that they are formed from vacuoles which contain proteids in solution. By loss of water in ripening the substance of the aleurone grain is precipitated through a physico-chemical process.

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[4] Day, David F.—A catalogue of the flowering and fern-like plants growing without cultivation in the vicinity of the Falls of Niagara. pp. 67. 8vo. Troy: The Troy Press Co., printers. 1888.

[5] Van Deman, H. E.—Report on the condition of tropical and semi-tropical fruits in the U. S. in 1887. pp. 149. pl. col. ill. 8vo. Washington: Gov't Printing-office. 1888.

[1] Ber. d. deut. bot. Gesellschaft vi. 199 (July 24, 1888).

Professor Jos. F. James, lately of Miami University, will become professor of botany at the State Agricultural College of Maryland at the opening of the college year in September. The institution is located very near Washington, so that scientific companionship is not lacking for the teachers there.

The extent of Dr. Gray's fame is well illustrated by the fact that many of the smaller foreign periodicals, not especially botanical, have given longer or shorter notices of his life and works. Our attention is called to such a sketch, written by Dr. P. Magnus, in the *Naturwissenschaftliche Rundschau*, published at Braunschweig, Germany.

The meeting of the botanical section of the Philadelphia Academy of Natural Sciences held on February 13 was devoted to memorials of Dr. Gray by various members, each treating of a different phase of his work. Addresses were made by Mr. W. M. Canby, Prof. J. T. Rothrock, Dr. W. P. Wilson, and Mr. Thomas Meehan. A suitable series of resolutions offered by Mr. J. H. Redfield was then passed and ordered on record.

In the last fascicle of the *Annales des Science Naturelles* (*botanique*) (vol. vii, parts 2, 3, 4) MM. Bornet and Flahault continue their revision of the Nostocaceæ of French herbaria. The present part includes the eight genera of the Nostoceæ, of which two, a new one, Wollea,[1] and Hormothamnion, are not found in Europe. From the enormous synonymy of some species, we judge that the revision has come none too soon.

Section F, at the Cleveland meeting A. A. A. S., was rather unfortunate in its secretaryship. The secretary, Dr. N. L. Britton, was absent at Kew, England. Mr. B. E. Fernow, chief of the forestry division, Department of Agriculture, was elected secretary *pro tem.*; but on Monday morning he received word of the death of his wife's father, and was obliged to leave. The conclusion of the duties devolved upon Mr. C R. Barnes, who was elected at the morning session.

De Vries has lately studied the young absorbing roots of plants with reference to the mechanics of the tissues. He concludes from the following experiments that either the so called "bundle-sheath" (*Kernscheide*) or the pericambium, or both, bear the root pressure. A root of Iris Pseudacorus, 12 cm. long, with the root tip uninjured, was placed under a pressure of 35 cm. of mercury. Every fifteen minutes a microscopically thin tangential section was cut from the root at a place 2 cm. from the tip. No water appeared at the surface of the cut until the sheath was reached, when immediately a drop was exuded. Similar experiments with like results were made upon the roots of Dipsacus sylvestris and the stems of various plants. He also shows how the sheath is adapted to resist the filtration of the water under root-pressure before it becomes suberized. De Vries also states that the movement of protoplasm in the cells which take up or transport water is such as to facilitate its passage to the vascular system in the interior. In the root-hairs the rotation is from one end to the other; in the epidermis parenchyma sheath and pericambium the chief stream passes over the tangential and transverse walls. The movement is strongest in the cells in which the absorption of water is greatest. As the suberization of the walls proceeds it gradually decreases, and ceases when the process is complete.[2]

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[1] Dedicated to our well known algologist, Rev. Francis Wolle, and including his Sphærozyga saccata.

[2] See abstract in Bot. Centralblatt, Band xxxv. 76 (1888).

VOL. XIII. NO. 10.—BOTANICAL GAZETTE.—OCT., 1888.

Development of cork-wings on certain trees. I.

EMILY L. GREGORY.

The name cork-wing has been applied to ridges of corky substance extending lengthwise along the young stems of certain trees and woody shrubs. One very prominent example is that of Liquidambar styraciflua, a tree which in the southern states attains a large size, the young branches of which are ridged with this cork formation, so that the tree, when standing leafless, has the appearance of being supplied with a set of troughs to conduct off the water.

This peculiar habit of growth is exhibited by several other species of trees, which, however, differ less in appearance from the ordinary bark-producing tree. Such are certain maples, oaks, elms and a few others. The peculiarity of the Liquidambar tree is that the wings of the lateral branches project mainly from the upper side, thus giving the tree in winter the curious appearance before mentioned. It was with reference to this one-sided growth, together with the large amount of material seen to be expended in what seems a useless appendage, that a brief study of the manner of formation of these wings was undertaken. This led to a similar study of some of the other trees referred to above. In the literature of cork and its development, this peculiarity is mentioned as of sufficient importance to admit of its receiving a particular name, but, so far as I have been able to learn, no special examination has been made of the so-called cork wings as distinguished from other forms of corky projections from the surface of dicotyledonous and coniferous growths. Dr. Carl Sanio, in his work on cork,[1] remarks, with true scientific candor, "It is extremely difficult to study the development of cork wings." Sanio's ability as an investigator and the amount and value of his contributions to botanical science are too well known to require proof here, and as this remark occurs in connection with what he says of the Liquidambar tree, it may be well to explain at the outset that the following results are not given as representing an exhaustive study even of the few species examined, but rather as an introduction to an intended wider and more detailed investigation.

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[1] **Pringsheim's Jahrbücher, 1860. Vol. II. Page 39.**

In the whole range of vegetable anatomy there is, perhaps, no other subject about which so much has been written, which still remains so obscurely treated in the ordinary textbook as that of cork formation in general, and more especially of that peculiar process which leads to the formation of bark. One reason for this is, without doubt, the lack of agreement among different authors in the use of the terms referring to the outer growths of woody stems of dicotyledons and gymnosperms. For example, several text-books, written in English, differ in the definition of the term bark, which, though acknowledged to be a general, rather than scientific term, still deserves to be used in a manner to make clear what part of the stem is meant. Another very probable reason is, the difficulty of the subject itself and the fact that each successive author, in writing upon it, introduces new terms and partially modifies the old. Owing to these facts, a summary of the terms used, with their definitions, together with a brief history of the subject, may be allowed before entering upon a description of the work done.

As to its history, it is, perhaps, unnecessary to state that cork was one of the first objects of microscopical investigation, as this was purely accidental. Robert Hooke, about the middle of the seventeenth century, invented an improvement on the compound microscope of that time, and in order to show the importance of his invention, used pieces of cork among other objects. H. von Mohl was the first to publish a description of cork in an article entitled, Untersuchungen über die Entwickelung des Korkes, etc.[2]. In this he showed that the bark owes its origin to the development of cork-lamellæ inside the rind.[3] Rudolf Müller[4] followed him, but his work was limited to the relation of the cork to the other tissues of the rind of deciduous trees. Later, Hanstein,[5] Schacht[6] and Schleiden[7] made various studies in this field. After them came Sanio, who says that the previous investigations have reference mainly to the relation between cork and the other rind cells, and that, while they make clear the meaning of this tissue in the household of cork-building plants, the history of its development, the law governing the succession of cell growth, etc., has not yet received attention. Schleiden had made the mistake of supposing the development to originate in all cases from the epidermal cells. Von Mohl and Hanstein attributed it to the first layer of primary rind cells. Sanio now made a more thorough study of it in reference to this point, and showed that there is no uniformity as to the place of origin of the cork tissue, but that it begins, in some cases, in the epidermal tissue, in others, in the first layer of primary rind cells, or in the second or third layer, and finally it may originate more or less irregularly, deeper in the rind tissues. The layer of cells which take on this activity, beginning to grow and divide, thus forming new tissue, was first named *cork cambium*. Nägeli named it *phellogen*. Sanio showed that from this layer the cells of the cork tissue were cut off toward the circumference; the same phellogen layer could also cut off cells toward the center of the stem, growth proceeding both in a centripetal and centrifugal direction. There was, however, this difference, the cells cut off toward the circumference were more or less corky in nature, while those developed on the opposite side of the phellogen layer became parenchymatic tissue and might contain chlorophyll.

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[2] Verm. Schriften, p. 212.

[3] *Rind* here in the general sense of German "Rinde," *i. e.*, all that part of the stem outside the cambium ring. Primary rind, those cells of the fundamental tissue of the stem between the epidermis and the ring of vascular bundles. Secondary rind, all the phloem tissue, both of the original vascular bundles and whatever secondary growth may be added from the cambium layer.

[4] Breslau Dissertation.

[5] Untersuchungen über den Bau und die Entwickelung der Baumrinde.

[6] Der Baum.

[7] Grundzüge der Wissenschaftl. Botanik. 3d edition. Page 283.

In 1877 von Höhnel[5] took up the subject again with special reference to the chemistry of the tissue, and gave as a reason for his investigations that, up to that time, the question, "What is the suberin of authors?" had not been answered; that there were two principal views on the subject, the one, that suberin is nothing more than a physical modification of cellulose; the other, that it is itself a substance forming an integral part of the wall whose foundation is cellulose. The latter view is fully sustained by his researches. He says suberin is just as distinctly a substance as cellulose or lignin. Farther than this, he shows how it is distributed in the wall and how it may be detected. By these tests he proves that much of the tissue heretofore considered cork consists largely of lignin, that these tissues alternate with each other, the lignin being produced early in the season, the suberin later.

It will be impossible to make clear what follows without an explanation of the technical use of terms as generally agreed upon by different authors on this subject, taking De Bary as authority wherever differences exist. Sanio named the cells cut off from the phellogen toward the center of the stem *phelloderm*, those cut off toward the circumference *phellem;* von Mohl made a distinction between the plate-formed cells, that is, those of short radial diameter, and the longer ones, naming the former cork, the latter periderm cells; this distinction being considered unscientific, inasmuch as both are developed alternately from the same layer, De Bary,[9] who wished to retain the term periderm, determined to refer to this word all that tissue originating from the phellogen layer. So that, as the terms are now used, periderm consists of two kinds of tissue, that developed from the phellogen, found on the outside of this layer, which is named phellem, and that formed on the inside of this layer, named phelloderm. According to von Höhnel, the phellem consists, or may consist, of two kinds of tissues—true cork cells, whose walls are suberized, and ligneous cells, whose walls are mainly wood. These latter are called phelloid, the former cork, and this without reference to the form of the cells, the substance of the cell wall being the ground of distinction. According to the plan of origin of the phellogen cells, there are two kinds of periderm, called superficial and deep-seated, sometimes, also, primary and secondary, as the superficial, when present, always precedes the deep-seated in order of time. De Bary makes this division, describes the superficial periderm and then says, "the position of the internal is not determinate in a sense generally applicable to all cases," and that this is owing to the number of transition forms between it and the superficial. He does not give the exact position of the phellogen layer of the internal periderm. Joseph Moeller,[10] in his Anatomie der Baumrinde, gives four classes of superficial periderm, considered with reference to the exact position of the phellogen layer. These, he says, may be reduced to three, when genetically considered. Of these three, the first is when the phellogen layer is the epidermis; the second, when it is situated in the primary rind; the third, when in the phloem of the vascular bundles. This last, he says, may be considered a transition form between the superficial and the deep-seated. For the latter, it must be inferred its place is in the phloem of the secondary growth, or the phloem produced by the cambium ring after it is completed around the stem.

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[5] Sitz. Berichte der Wiener Akad. d. w. Nov. 1877. LXXVI. I. p. 587.

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[9] Comparative Anat. of Phanerogams and Ferns (Eng. trans.), pp. 114 and 544.

[10] Anatomie der Baumrinden. Vergleichende Studien von Dr. Joseph Moeller. Berlin, 1882.

Difficult as it is to harmonize the different ways of describing the processes of periderm formation, as given by various writers, nearly all agree in the main features of that by which bark is produced, viz: bark is the product of the internal or deep-seated periderm, and it consists of all that portion of rind-tissue outside of this periderm, which tissue, cut off from nourishment by the corky layers of periderm, dies and is eventually thrown off. This is the *Borke* of the Germans and the *ecorce crevassée* of the French.[11] One form of internal periderm originates from phellogen cells extending in a nearly continuous layer around the stem; this gives rise to the so-called ring-bark, examples of which are Vitis and Clematis. Another form of internal periderm arises deeper in the rind of certain stems on which there is already a superficial periderm. The phellogen cells of this form, instead of extending in one layer around the whole circumference, arise in such a manner that, as De Bary expresses it, "they abut on the outermost layer of periderm for the time being," referring here to the repeated formation of internal periderm; the cork thus formed cuts off bark in the form of scales. The favorite example of this is the Platanus. Hence the two kinds, ring- and scale-bark. Now, accepting the definition of bark given by De Bary[12], we must exclude all those trees from the list of bark-bearing ones which do not have, at some period, one of the two forms of internal periderm. He quotes this definition, however, from von Mohl, and does not himself adhere strictly to it, as on a page or two previous he gives an instance of phellogen arising in the second or third subepidermal layer and cutting off a *small bark*. This, according to both De Bary and Moeller, must be considered as a superficial periderm, and the latter adheres more consistently to the definition of bark, inasmuch as he gives only 83 genera of bark-producing trees among the 392 specimens which he examined, and he expressly states that these 83 kinds possessed internal or secondary periderms.

Now, according to De Bary's explanation of superficial periderm, which differs from Moeller's only in its lack of definiteness, it is with this kind of periderm alone that our subject has to do. In connection with this, is one point seldom noticed in text-books, and that is, that the superficial periderm also gives rise to two kinds of coverings, which De Bary names suberous crusts and suberous integuments (kork-krusten und kork häute). These two forms owe their origin to the difference in the manner of development of the cork or corky layers. Here De Bary classifies, apparently without reference to form of cell or nature of wall, meaning by cork the phellem, or all outside the phellogen layer. Where this develops with nearly equal rapidity around the whole circumference, it forms the suberous integument; where, owing to some cause, the development is irregular, certain portions of the phellogen producing faster than others, suberous crusts are formed, and it is in this category that he puts the cork-winged trees, together with all those having deep, irregular furrows and ridges along their surface.

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[11] Traite de Botanique par J. Sachs. Traduit de l'allemand sur la 3d edition et annote par Ph. von Tieghem. 1874.

[12] Comp. Anat. p. 551.

It is in reference to certain differences in various cork-winged growths that the following study has been made, the author believing herself to have noticed some facts which may have a bearing on certain physiological questions at present under consideration. Although the number of species examined was quite limited, yet, for the sake of convenience, they may be considered as represented by three types, *Quercus macrocarpa* Michx., *Liquidambar styraciflua* L., and *Euonymus alata*. The latter genus is extremely interesting from a systematic standpoint. No two species examined agreed in the manner of cork development, while a variety differed from its species only by a slight and unimportant variation. Quercus macrocarpa, and those agreeing with it in structure, deviate less than the others from the so-called rough-barked trees, or those whose trunks are ridged and furrowed while their branches are smooth. The younger branches of Q. macrocarpa, however, are completely covered with a set of wings, generally five in number. The manner of their origin is as follows:

ANATOMY OF THE SUPERFICIAL PERIDERM OF Q. MICROCARPA.

Stems were examined July 10, which were taken from a tree a few days before from the Arnold arboretum, and which had been kept in a fresh, growing condition. At this time the young stem was covered with a periderm of six or seven layers; even the youngest internodes on the shortest branches, some not exceeding two millimeters in length, were covered with a periderm of six or seven layers in thickness. Lenticels were very numerous over the whole internode. The wings do not originate until the internodes have reached about their full length. Their manner of origin may be said to follow a fixed law, though very many irregularities occur.

The stem, when young, is conspicuously five-angled, owing to the strongly developed leaf-traces. The periderm takes its rise from the subepidermal layer, developing uniformly around the stem till about five or six layers of cork have been formed. The epidermal cells, at first, appear to yield to this strain by stretching in the direction of the circumference until their tangential much exceeds their radial diameter. The large number of lenticels which develop at the same time with the periderm appears to diminish this strain somewhat, but as the growth of the periderm continues and the epidermal cells reach their full tension, they break at various points over the surface. At the projecting angles, where the strain is greatest, this giving way of the epidermal cells soon becomes insufficient to allow the necessary expansion, and the young, fresh periderm breaks in lines along these angles. A cross section at this stage shows from five to seven layers of periderm cells, which are living and active, as shown by the action of sugar solution when applied to them, plasmolysis at once taking place. Glycerine was tried, but produced no effect. It is quite probable it was not sufficiently dilute, as the solution was made at random in both cases. There can be no question about the result when the sugar solution was applied, and in several instances the cell nucleus was clearly seen. The tearing of these cells along the angles extends inward nearly to the phellogen layer, and, as a result, an abnormal vitality seems to be imparted to the phellogen cells immediately under the fissure. For a time this increased vitality of the phellogen layer does not extend entirely around the circumference, but only for a short distance each way from the fissure. This will be better understood by referring to the figures,* of which the first six represent this process of wing-development diagrammatically. In figure 1 the tearing of the tissue along the lines of the five angles is represented as lying at the points *a. a.* The bands of tissue represented as lying between the angles *o. o.* are composed of the original periderm of six or seven layers which first encircled the stem. In figure 2 the new growth of cells shown at *x. x.* is the product of the increased vitality of the phellogen cells near the fissure. This rapidity of growth and ability to form new cells by forming cross-walls in various directions is not confined to the phellogen layer of this vicinity, but extends also, for a limited time, to the cells produced by this layer. This is shown in figure 7 at *m.* This figure gives the actual appearance of a cross-section of stem, as represented by figure 2. Here it is evident that some of the cells, resulting from the division of phellogen cells, are themselves in the process of division. As represented in figure 2, this development of new cells extends only to the points *b. b.*, and is most rapid immediately under the line of the fissure. As growth continues for some time in about this ratio, the result is, the five sections of original periderm, *o. o.*, are not only pushed out, but the ends of each are curled toward each other, thus making a hollow furrow along the internode. This condition in its formative stages is represented in figures 4, 5 and 6, sections *o. o.*, the figures being made smaller merely for convenience as the real size of the wings increases. On testing these specimens with reagents, it was found that the cell walls of the sections *o. o.* consisted principally of suberin, while those formed later, represented by sections *x. x.*, are not true cork cells, but ligneous, and correspond to the phelloid of Höhnel. Figure 8 shows the actual appearance of these cork and phelloid cells, as represented in figure 4. Figure 9 shows merely the tip of the wing of figure 6.

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*The plates will be published with the remainder of the text in the succeeding numbers.—Eds.

This matter of difference in the chemical nature of the cell walls will be referred to again in connection with the physiology of the wings, where its consideration more properly belongs.

Returning now to the stage of growth represented in figures 2 and 3, it will be plain there are five longitudinal bands of rapidly growing tissue extending along the internode across each angle, while there are also bands between these, in which growth is for the time suspended. At what time the phellogen cells of these bands begin their activity again it is impossible to say. Sections cut from a two years old stem, of which figure 8 is an exact representation, so far as the outline of the different tissues is concerned, show that in this case growth of the phellogen cells of these five bands was suspended till toward the close of the summer's growth ; then activity commenced all around the circumference of the stem, and the narrow plate cells, *y*, were formed, extending entirely around the stem. In most cases, however, it is probable that growth of the entire phellogen layer is resumed earlier in the season than in the case of the section from which figure 8 was taken, and that, for some time, the same kind of tissue is produced as that forming the first five bands, viz: phelloid tissue, referred to on the figures by *x*. After some time the fall growth occurs and the ring of plate cells, *y*, is formed. This must have been the case in figure 9, which is also an exact representation of a section from another stem. Nearly all completed wings examined agree with figure 9 in this respect. It happened that the specimen from which figure 8 was drawn was the only one found which illustrates this stage of growth, that is, the gradual throwing outward the ends of the sections *o*, *o*, which process forms the furrow. This is, therefore, given to prove the manner of growth in this respect, while it is probable that figure 9 shows the most common form in respect to the time when the whole phellogen layer resumes its activity. However this may be, it never fails that in the autumn, just before growth of the entire tree is suspended, several layers of narrow plate cells are formed, whose chemical nature is the same as that of the first periderm sections *o*, *o*. The fissure, at this time, extends in some cases entirely down to this mantle of thicker walled cells; in the specimen sketched, figure 8, still several layers are left intact between the ring of plate-cells and the outside air. In this condition the winter is passed. In the spring the entire phellogen layer resumes its activity, rapidly developing phelloid cells with thin walls and long radial diameter. This continues till the strain is too great to be borne by the walls of the surrounding plate-cells, and they break regularly along the lines of the preceding years' fissures, *a*, *a*. Growth continues during the summer nearly uniformly as the foundations for the wings are laid, and the breaking of the new tissue follows the lines already begun. At the close of the second season the same process occurs as in the preceding fall, viz.: several layers of narrow plate-cells are formed around the entire circumference. In this way large cork wings are formed, enlarging each year at the base as the stem increases in thickness. It is seldom that they are perfectly regular in their whole length, but on nearly all the older branches the number five may be recognized, and the little hollow furrow running along the top of each wing may be plainly seen. Fig. 10 shows a cross-section of a stem four years old, in which only two of the wings show the furrow, owing to the fact that at the point where this section was cut, the furrows of the remaining three wings were not perfectly developed. As the phelloderm plays no important part in the formation of cork from the standpoint of our subject, no attention was given to this throughout the study made.

Philadelphia, Penn.

Characteristic vegetation of the North American desert.

DR. GEORGE VASEY.

The term desert has a somewhat wide application. In one sense it is applied to a tract of country practically destitute of vegetation from sterility of soil. Such sterility, however, is not always the fault of the soil, but is due to the absence of water in sufficient quantity to promote vegetation. Our ideas of a desert are largely drawn from popular descriptions of some portions of the Great Sahara, where low plains covered with drifting sand, interspersed with vast fields of naked rock, spread over regions over which the traveler might pass for days without meeting with a drop of water or a blade of grass. Such cases are met with, but then occasionally an oasis is met an island of verdure, where, around cool springs of water, flourishes a tropical vegetation of palms, ferns and acacias. But this description covers only a part of what is known as the Sahara Desert.

Explorations of travelers and scientists show that the great desert is a region of elevated plains rising up into mountains of 300 to 500 feet in height, and separated from each other by valleys, immense sandy tracts at a general elevation of from 1,200 to 1,500 feet, but sinking at times into depressions which sometimes descend below the level of the sea.

The moisture from the Mediterranean Sea is arrested in its southward passage by the range of mountains running nearly parallel with it, and is mainly precipitated on the north or Mediterranean side; thus the southern slopes are left in an arid condition, the aridity increasing as the country recedes from the mountain ranges and peaks, where snow falls in the winter, and, melting in the summer, runs down the narrow courses and ravines until it is finally wasted in the sands of the desert. Similar causes, as is well known, operate in our own country for the production of our arid districts, particularly in what is called the Great Basin. A few years ago it was the custom to speak of the country now embraced in the states of Kansas, Nebraska and New Mexico as the Great American Desert.

A large portion of this country, although blessed with but a limited rain-fall, proves to be capable of remunerative cultivation.

There are some stretches of loose, sandy soil supporting only a sparse vegetation of Chenopodiaceous shrubs and coarse grasses, but these are of limited extent.

It is to the strip of country lying at the eastern base of the Sierra Nevada range of mountains, and at the south where this range breaks down into high and extensive plateaus in Arizona and southeastern California, that we find our nearest approach to a true desert, and to this region our remarks will, for the most part, be confined. For a general description of the physical features of this region I shall avail myself of many of the observations of Mr. Sereno Watson, as given in his report of the botany of the 40th parallel.

In the northern part of this district the basin extends from the base of the Sierras eastward to the Wahsatch Mountains, a distance of over 400 miles. This span is occupied mainly by numerous short and isolated and minor ranges, having a general north and south trend, and at an average distance of about twenty miles. The bases of these ranges are usually very narrow, even in the most elevated rarely exceeding eight or ten miles in breadth, the slopes abrupt and the lines of foot-hills contracted, the mesas grading at a low and uniform angle into the broad interrupted valleys. Over the larger portion of the territory, especially in Nevada, the combined areas of the valleys and the areas occupied by the mountains are very nearly equal. The greater portion of the basin at this point is drained by the Humboldt River, which traverses the territory from northeast to southwest, and terminates in Humboldt Lake, which has no outlet. The other smaller streams of the region likewise lose themselves at other points in the main depression of the basin at an altitude of about 3,800 feet above the sea. The mountain ranges of the basin vary in altitude from 1,000 to 6,000 feet above the valleys.

"They are cut up by numerous ravines or cañons, which are narrow, very rarely with an acre of interval or surface approaching to a level, the sides sometimes rocky or precipitous, more frequently sloping to the summits of the lateral ridges. With few exceptions, also, these mountains are for most of the year destitute of water, with but small rivulets in the principal cañons, frequently with only scant streams here and there at their bases, irrigating a few square yards of ground. Even where the mountain supply is sufficient to send a stream into the valleys, it is usually either soon entirely evaporated, sinks into the porous soil, or becomes demoralized with alkali and is lost in the mud of the plain."

The amount of rain-fall in this region is not definitely known. "It varies greatly with the altitude, and is probably considerably more upon the eastern slope of the mountains than upon the western. Though any statement of the average annual amount must be largely conjectural, yet it may be roughly estimated at eighteen inches, of which one-half may be considered as falling between April and November, inclusive." "No portion of this district, however desert in repute and in fact, is destitute of some amount of vegetation, even in the driest seasons, excepting only the alkali flats, which are usually of quite limited extent. Even these have frequently a scattered growth of Sarcobatus or Halostachys surmounting isolated hillocks of drifted sand compacted by their roots and buried branches." With these in alkaline soils are usually combined several other Chenopodiaceous plants, such as Salicornia herbacea, several species of Suæda, Kochia prostrata, Eurotia lanata, Grayia polygaloides, Schoberia occidentalis, and several species of Atriplex. In addition, there are two species of Thelypodium, three of Cleomella, one of Astragalus, two species of Aplopappus, one Crepis, one Cressa, Lycium Andersoni, Erythræa Nuttallii, and of grasses chiefly Distichlis maritima, Spartina gracilis and Sporobolus asperifolius. There is an almost universal absence of trees. In the valleys of the Humboldt, Truckee and Carson Rivers, Populus monilifera and P. trichocarpa are found sometimes in considerable numbers. Several shrubs besides those mentioned above, sometimes mingled with those in alkaline soils, as the "everlasting sage-brush," Artemisia tridentata, and the similar, but smaller, Artemisia trifida. These are often accompanied by Bigelovia graveolens, called broom-sage, and Tetradymia canescens, and along the fresh water streams two species of shrubby willows. On the foot-hills only is found the shrubby

Purshia tridentata. "The mountains are, in a large measure, as destitute of trees as the valleys, or even more naked, from the dwarfed character of the shrubs upon the exposed ridges and summits."

On the higher ranges a sparse supply of Pinus monophylla, the nut pine, with two or three species of Juniperus, or red cedars, is to be found. The mountain mahogany, Cercocarpus ledifolis, is of frequent occurrence on high ranges at an altitude of 6,000 or 8,000 feet.

Mr. Watson gives a list of the peculiarly desert species of the northern portion of the basin, amounting to 305, of which about one-third are strictly confined to the basin, quite a large number of which are southern and have extended up from the desert portions of Arizona and southeastern California. Going southward, the desert district by the trend of the Sierras is deflected eastward, and in the southern part oi Nevada the Rio Virgin and its branches are reached, where the drainage of the country is to the Colorado River. A little further south, the Mohave River, coming in from the west, traverses the desert region of southeastern California. Crossing the Colorado into Arizona, we find that entire state and the western portion of New Mexico drained by the Little Colorado and the Gila Rivers, having their origin and affluents in various mountain ranges, some of which rise to 10,000 to 11,500 feet altitude, furnishing above 6,000 feet exclusive forests of pine, spruce and cedar. At elevations of 6,000 feet several species of oak and other deciduous trees are sparsely spread over the mountain declivities. The country then descends into broken plains, or in some places, particularly in the northern portions bordering the Colorado, into extensive plateaus. Over a large portion of the state these plains afford a scanty supply of grasses and small shrubs which give support to thousands of cattle, but often they become dreary stretches of barren, sandy soil entirely destitute of water for distances of from twenty to fifty miles. The vegetation of these plains and mountain slopes becomes very peculiar and striking. I will quote a few paragraphs from Dr. J. T. Rothrock in his description of this remarkable region. He says: "Crossing a series of mesa lands at an elevation of 6,000 to 7,000 feet, we begin the descent to the parched, superheated valley of the Gila River. A complete change comes over the flora. If verdure and superabundant vitality were the expression of the plant life on the timber-clad Mogollon mesa, in the valley of the Gila, hardness of texture and contraction of form would be characteristic of the flora. The attempt to make an analysis of one's feelings on being somewhat unexpectedly brought face to face with this peculiar vegetation would be futile, as no point of comparison appears to offer. The giant Cereus occupies the hill-sides which have a southern and southeastern exposure, towering up to a height of from thirty to fifty feet. Fouquieria, with the leafless, wand-like trunk, and its tips of scarlet flowers; Agave Palmeri and Agave Parryi, and various species of Dasylirion, dry, rigid skeletons of plants without the living green; Canotia, a tree twenty feet high, a foot in diameter, with green branches provided with stomata, but no leaves, all go to complete this desolate floral landscape, white with Mimosa. Acaciæ and Calliandræ, rising to the dignity of trees or dwarfed to mere underbrush, inhabit the dry hillsides and ravines, but still by their small leaves and hardened tissues show that they, too, have the impress of the dry, hot air about them." One of the most conspicuous of the desert shrubs is Larrea Mexicana, commonly called creosote-bush, which has a strong aromatic fragrance, plainly perceptible in the air, and exuding a reddish-brown resinous matter on the branches. It is reputed to have strong medicinal virtues. Several kinds of Rhamnaceous shrubs also are frequently met with, among them species of Zizyphus and Karwinskia. The order Leguminosæ has a pretty abundant representation in peculiar species in the desert region, particularly the genera Astragalus, Galea, Cassia, Acacia and Mimosa.

The mesquit tree, Prosopis juliflora, extends through the dry regions from Texas to southern California, sometimes becoming a tree of from thirty to forty feet high, and forming dense thickets, more commonly a mere bush, bearing freely bean-like pods, which are valuable forage for mules and horses while making hard marches. The wood is frequently the main dependence for fuel. Several thorny shrubs of the genus Parkinsonia, with smooth, light-green bark, and small, scant leaves, but conspicuous contracted pods, form a common feature of the landscape. But the most abundant and characteristic plants of the desert region are the many genera and species of Cactaceæ, varying from the giant Cereus to the various forms of flat-branched and cylindrical Opuntias, intermixed with Mamillarias and Echinocacti in great number. Cereus giganteus, or the tree cactus, attains a height of from twenty to fifty feet, and is probably half a century in attaining its maximum size. It is sometimes entirely unbranched, but often with a few, two or three, or even up to nine branches, which, almost immediately after leaving the trunk, turn upward and grow parallel with the main stem, presenting sometimes the appearance of an immense candelabrum. The trunk of the older trees is often two feet in diameter. It begins to flower when ten to twelve feet high. The flowers are borne near the summit of the stem and branches, and are succeeded by a roundish or pear-shaped fleshy fruit two to three inches long by one and one-half to two inches thick. The interior of this fruit is of a crimson color when ripe, of the consistency of a fig, and of a sweet, but rather insipid taste. They are eaten by the Indians of the country, who reach and detach them by means of a long pointed reed. Cereus Thurberi is a smaller species, found in southern Arizona and thence into Mexico. It grows in clusters of five to ten stems from one root, and rises to the height of ten or fifteen feet. The fruit is said to be delicious. Many genera of Compositæ have a great development in the desert region. In the sandy arroyos there occur several species of Baccharis, together with the well-known Indian arrowwood, Pluchea borealis. Other genera are Brickellia, Aplopappus, Bigelovia, Verbesina, Riddellia, Pectis, Tagetes, Artemisia, Perezia, Lygodesmia, etc. Many species, also, of Convolvulaceæ, Solanaceæ and Scophulariaceæ are conspicuous. A Bignoniaceous shrub (Chilopsis saligna), with handsome corymbs of flowers, sometimes enlivens the dreary stretches of land, especially in the vicinity of water, and, on account of its narrow, willow-like leaves, is known as the desert willow. The orders Amarantaceæ, Chenopodiaceæ and Euphorbiaceæ are represented by many species. Next the Cactaceæ, the most striking features of the vegetation are the various species of Agave and Yucca. Yucca baccata usually has a short stem, but in the southwest it sometimes develops a trunk eight or ten feet high covered with refracted dead leaves, and bearing at the apex a large panicle of lily-like white flowers, which are succeeded by an indehiscent, fleshy pod; these are eaten by both whites and Indians, and cured by the Indians for winter food. They also stew the flower buds and flowers, which are said to be nutritious. Yucca brevifolia makes a tree from fifteen to thirty feet high, with rough barked trunk one to two feet thick, dividing into a number of branches, each of which is terminated by a close tuft of thick, stiff leaves six to ten inches long, and below covered with older dead and reflexed leaves. This species was some years ago largely collected and manufactured into paper and paper pulp. It forms, in some places, quite extensive scattered forests, which have a very peculiar appearance. The narrow-leaved Yucca (Y. elata) occurs on dry hills and ridges, has a trunk three to ten feet high, with extremely narrow leaves one foot to eighteen inches long, and throws up a narrow panicle as long as the trunk. It is one of the most stately of Yuccas. Yucca Whipplei is abundant in Southern California, extending eastward into Arizona. It has a short trunk, with leaves ten to twenty inches long, and sends up a lower scape to the height of from four to twelve feet, bearing a densely flowered, narrow panicle of greenish-white flowers, which are succeeded by capsules one to two inches long. The leaves furnish a coarse fiber which is used for stuffing saddles and similar purposes.

In the desert region several species of the genus Agave are conspicuous, among which are Agave Schottii, Agave Utahensis, Agave Newberryi, Agave deserti, Agave Parryi, Agave Palmeri, and, in the southwest corner of California, Agave Shawii. The Agaves are chiefly stemless plants with a mass of large, stiff and pulpy leaves crowded together at the surface of the ground, which leaves are generally armed on the margins with coarse, spiny-tipped teeth. There is said to be over 120 species of this genus in Mexico, one of which, called the maguey plant, is of immense importance in furnishing that universal Mexican beverage called pulque. In the vicinity of Mexican cities immense plantations are given up to the cultivation of the plant. At the proper time the crown of the plant is cut out and an excavation made, in which a stream of juice continually flows, and is collected daily by a man who is called a pulquello, going through the fields with a leathern sack on his back into which he pours the pulque fluid, which he takes from the excavations with a dipper. This fluid, after fermentation, forms the beverage above named, which is in universal use among the Mexicans.

A striking feature of some of the dry, sheltered cañons of western Arizona and southern California is the American palm, Washingtonia filifera. It attains a height of thirty or forty feet, with a cylindrical trunk two to three feet in diameter, crowned at the top with rather a close tuft of much divided leaves, whose margins are ornamented with loose, hanging threads. This palm is now cultivated for ornament in many places in California, and has also been introduced into green-house culture in Europe. An attempt has been made at one place in southern California to utilize a portion of the rough barrens country for an ostrich farm. Ostriches have been introduced from Africa, and are kept in large inclosed tracts, where they have abundant freedom. The climate seems to be quite agreeable to them, and their culture promises success.

Washington, D. C.

The stem of Ephedra.[1]

WALTER H. EVANS.

(WITH PLATE XXI.)

According to Bentham and Hooker, Ephedra occupies an intermediate position between Welwitschia and Gnetum in the order Gnetaceæ. Holding thus a low rank among Gymnosperms, we would expect interesting anatomical structures. In all there are about thirty species, most of which are tropical. Within the United States five or six species have been found, and their range is from Ft. Bridger, Wyoming territory, Colorado and Texas, through Utah, Nevada and Arizona to California.

In this study I used the *Ephedra Nevadensis* Wats. and compared with it *E. aspersa* Engelm., *E. pedunculata* Engelm., *E. vulgaris* Rich., *E. trifurca* Torr., and *E. monostachya* L., all of which seemed to differ in no important detail from the type used.

To the casual observer the stem of Ephedra seems to be a jointed affair, branching variously and attaining a height of from six inches to as many feet. He is struck with the close resemblance which the young branches bear to the common horse-tail rush. The stem bears no leaves, but at the nodes of the young shoots are two or three scale-like bracts one to six lines long and usually of a brownish color. In the cases observed, all these scales were deciduous after the first year's growth, while in some cases they were not retained throughout the growing season. These scales are, in all probability, rudimentary leaves, yet they do no leaf work, have no fibro-vascular connection with the stem, and seem to be but developments of the cortex and epidermis. In the axils of these bracts occur whatever flowers or branches the plant bears.

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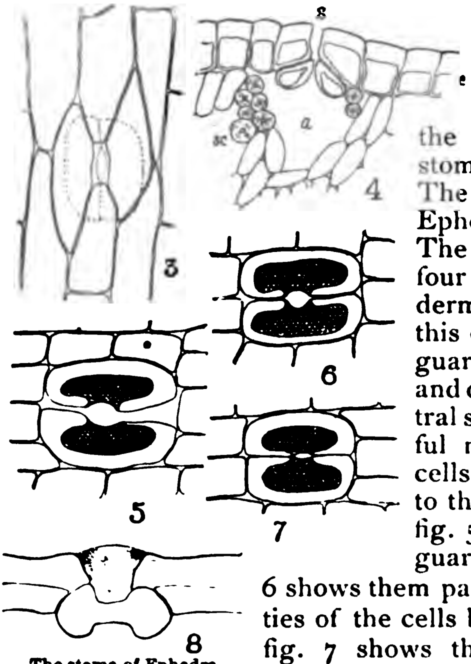
[1] Contribution from the botanical laboratory of Wabash College.

The epidermis of the stem is rather rough, and is composed of irregularly shaped cells. The outer wall is often considerably cuticularized, frequently becoming half the thickness of the cell. Numerous processes, like very rudimentary trichomes, cover the epidermis, and in optical section give it the appearance of being covered with small knobs. The cortex (fig. 1, *c*.), is for the most part made up of palisade parenchyma, containing chlorophyll. This chlorophyll-bearing parenchyma completely invests the young shoots except at the nodes, where it is abruptly terminated. Within this part of the plant all the leaf work is done. As the stem increases in age the epidermis becomes more cuticularized, the wood tissues encroach more and more upon the cortex, and when from three to five years old its leaf work is over and the stem has lost all resemblance to the rush.



The stoma of Ephedra, x 250.

Arranged either in single or double vertical rows in the epidermis, and leading into the cortex, are found the stomata (fig. 2, *s*, *s*, *s*, etc.). The stomatic structure of Ephedra is a curious one. The opening is formed by four specially developed epidermal cells (fig. 3). Below this opening are placed the guard cells, two in number, and ovate triangular in a central section (fig. 4). By careful manipulation the guard cells may be seen to respond to the presence of water. In fig. 5 is shown a stoma with guard cells wide apart. Fig. 6 shows them partly closed, the extremities of the cells being in contact; while fig. 7 shows them still more nearly closed. Indeed it is only after a long soaking that the slit opening can be entirely closed. Of course, this process is presumably the reverse of that which would take place were the guard cells in their normal position in relation to the surrounding tissues. In fig. 8 a longitudinal radial section of the stoma is given. Below the stoma the usual air-chamber is found.

Scattered singly or in groups of from two to ten within the cortex, and also the pith, are found very long sclerenchymatous fibers. They are thick-walled and shining. Their length is indefinite, but seems usually to equal that of the internodes. These fibers are much more numerous in the cortex than in the pith. Next within the cortex is found the bundle sheath of very delicate walled cells. Within this is the phloem, containing the sieve vessels and the accompanying cells of soft bast. Next comes the xylem area, resembling that of Pinus very much, having rectangular-shaped cells with heavy lignified walls. The medullary rays are not very prominent even in the most favorable circumstances. Within the xylem area, and forming the central part of the stem, is the pith, of rather large irregular cells.

In my study I used, with good results, chlor-iodide of zinc as a staining fluid. The xylem and the pith take on but little stain, and are seen as yellowish brown. The phloem takes on a very pretty blue, the cortex a darker color, and the sclerenchymatous fibers a beautiful pink. If the sections stand too long in the reagent, the phloem and the parenchyma adjoining it take up so much color that they can not be readily distinguished. No trouble can be met with in distinguishing the characteristic cells of the xylem and the pith.

In longitudinal radial section we get a very similar arrangement of parts as in transverse section. The epidermis, cortex, sclerenchymatous fibers and bundle sheath, except as mentioned already, differ in no respect from the forms usually characterizing such tissues. The phloem is composed of cells of considerable length. They are rather thin-walled and have blunt ends. In the xylem area there are striking differences. Some of the cells are quite long as compared with surrounding ones. These long cells are generally horizontally or spirally banded, and the walls are rather thick (fig. 10, *sp.*). Other cells are shorter, and have the usual tapering ends of all tracheids. Most of these are more or less spirally banded, and have thinner walls. Some in the older wood have the characteristic disk markings of all gymnospermous stems, while others have both the disks and spiral markings. The pith cells are different in no respect from those found in such stems. However, it often contains a sort of reddish brown coloring matter, a secretion which is soluble in water at ordinary temperatures, showing it can not be "a kind of resin," as has been claimed.

Just above each node, except in E. monostachya, is found a most curious structure. Running across the stem is a sort of diaphragm of three or four cells thickness. This completely cuts off the pith and often the xylem also (fig. 11). Whenever any of the tracheids pierce this they are the long, heavy-walled ones spoken of above. After acting as an almost complete partition in the region mentioned, it seems to merge into the phloem on either side. The cells making up this curious structure are rather thin-walled, and about three times as long as broad. When treated with chlor-iodide of zinc they take the characteristic color of the phloem. Just what the office of these cells can be, I am not prepared to say. They may be active meristem cells, and the growth of the internode may be found in this layer. I found that wherever this exists it forms a line of easy division, and the brittle stems always break at this point. If the other habits of the plant would warrant it, this may be a means for propagation, since by breaking as it does there can be no injury to the node, and if the plant will grow from cuttings this may be nature's way of providing them.

Crawfordsville, Ind.

EXPLANATION OF PLATE XXI AND FIGURES IN TEXT.—Fig. 1. Cross section of stem: *e*, epidermis; *c*, cortex; *b*, bundle sheath; ***ph***, **phloem**; ***xy***, xylem; *p*, pith; *sc*, sclerenchymatous fibers; *s, s, s*, stomata; *a, a, a*, air chambers.

Fig. 2. Surface section of epidermis, showing vertical rows of stomata.

Fig. 3. Epidermal cells surrounding a stoma.

Fig. 4. Cross section of stoma: *s*, stoma, guard cells below; *a*, air chamber; *e*, epidermis; *sc*, sclerenchymatous fibers.

Fig. 5. Guard cells dry.

Fig. 6. Same, partly closed.

Fig. 7. Same, nearly swelled shut.

Fig. 8. Longitudinal section of stoma.

Fig. 9. Longitudinal section of stem, lettered as in fig. 1.

Fig. 10. Elements in longitudinal view: *sc*, sclerenchymatous fiber; *sp*, long tracheid; *tr*, forms of tracheids; *p*, pith.

Fig. 11. Showing diaphragm above node as in longitudinal section.

Fig. 12. More highly magnified portion of same.

Figures 3—8, × 250; 1, 2, 9, 10, 12, × 125; 11, × 24.

A tramp in the North Carolina mountains. I.

L. N. JOHNSON.

One of the wildest regions east of the Rockies, and at the same time one of the most interesting to a botanist, is the mountain region of western North Carolina. The combination of low latitude and great altitude produces, as might be expected, a varied flora.

It was the good fortune of the writer to be one of a party who tramped through these mountains during the past summer on a botanizing trip. Our route was two hundred miles long, extending through Jackson, Macon and Swain counties. We had laid it out in such a way as to cover both mountain peak and valley.

One might fill pages with descriptions of the beauties of the scenery, but we must here confine ourselves to the flora, and that briefly. Although our trip was made just too late for the spring flowers and before those of summer were fully developed, we identified about five hundred and fifty species without any attempt at an exhaustive study.

Of course the Compositæ headed the list in number of species, but to us the most striking feature was the great abundance of the Leguminosæ, both in species and individuals. The soil is a red clay and seems to be peculiarly adapted to them. We found thirty-five species in blossom. Along the roadsides, especially in the valleys, were great quantities of the showy flowers of the Butterfly peas, Clitoria Mariana and Centrosema Virginiana. Scarcely less abundant, but perhaps more local, was the Schrankia uncinata. The Cherokees call this the "Bashful brier," in allusion to the sensitive character of the leaves. Of course, the common clovers are seen, though the white clover is not so abundant as in the north. The turf by the roadside in many places is made up by the stalks of a small leguminose plant with trifoliate leaves, somewhat resembling clover. It was not in blossom at the time we saw it.

Desmodiums are very abundant and of many species. One of the most variable of the Leguminosæ that we found is the Stylosanthes elatior. Its yellow blossoms were everywhere, but its stalks were sometimes erect, at others almost trailing, while the leaves vary in form and size. A very showy member of the family is the Thermopsis Caroliniana.

Its tall, simple stalk and long raceme of yellow flowers catch the eye here and there on the mountain side, though it is not abundant.

Among the other interesting Leguminosæ which one may hope to find are Rhynchosia tomentosa, var. erecta, Phaseolus perennis and P. helvolus, Tephrosia spicata, and a dozen others.

In striking contrast with the abundance of Leguminosæ is the almost total lack of Cruciferæ. We found only four species in all the mountains.

Of the Compositæ, the most conspicuous members in July are the Cacalias and the Silphiums. C. atriplicifolia and C. reniformis represent the former genus, while there are three species of Silphium found in abundance. Of course Asters are plenty, though our trip was a little too early for them. At Tuckaseege Falls we found Cynthia Dandelion and its variety montana growing abundantly on rocks continually wet by the spray. Elephantopus tomentosus was another species new to us.

The Rubiaceæ are everywhere well represented by Diodia teres, several species of Houstonia, which are among the commonest weeds, and by a number of Galiums.

The list of common flowers might be almost indefinitely extended. Probably none would sooner attract the attention of a stranger than the "wild potato vine," Ipomœa pandurata, growing with the beautiful passion flower (Passiflora incarnata), and its smaller relative, P. lutea, everywhere in the cornfields.

We have spoken thus far of some of the common flowers one may hope to meet with in a tramp through the mountains in the latter part of June or in July, purposely omitting the Ericaceæ till some future time. Now let us turn to the question of habitat.

We climbed Whiteside and Wayah Bald, two of the highest peaks in that section of the state, naturally hoping to find many new plants. In each case we were somewhat disappointed. On Whiteside, though the species were numerous, we found very few things not afterward seen in the valleys, the only ones being the little heath, Leiophyllum buxifolium and the rock fern, Asplenium Ruta-muraria. On Wayah Bald we found Pogonia pendula and an abundance of Potentilla tridentata. On the slopes grew the Chamælirium luteum, which is usually considered a lowland plant. Though we found so few new plants on these high summits, we were greatly surprised at some of the things we did find. On the very crest of Whiteside, in the dry soil, were no less than four species of Orchids, all of them found in the swamps of the lowest parts of the state visited. This was not an unusual case, for it became an object of common remark among us that distinctions of habitat fail here. Most of the plants seem to be found indifferently on the mountain tops and in the valleys, on dry slopes or in the swamps.

The effect of altitude on the time of blossoming of some of our common plants was clearly seen. We often found the Hypoxys erecta in blossom, and on Whiteside we found Aquilegia Canadensis in bloom on the 12th of July, and on the Nantehala mountains a week later the Tiarella cordifolia, both early spring flowers. It was unexpected to find these flowers in their prime so late in the season at a point so far south.

Evanston, Ill.

BRIEFER ARTICLES.

New variety of Asclepias tuberosa.—Asclepias tuberosa is one of the well marked species of the genus, with its hairy stem (destitute of a milky juice), scattered leaves and orange-colored flowers. Only one variety, decumbens, is given in Gray's Synoptical Flora. A form different from this, and one which seems to be well entitled to a varietal name, has been in my herbarium for some years, and I now wish to characterize it as a new variety.

Asclepias tuberosa, var. *flexuosa*. Stem flexuous: leaves sub-opposite, a pair at each node: the flexuous stem is caused by a peculiar curvature of the internodes.—Cumberland mountains, Tennessee. *Miss M. Mohr.*—JOSEPH F. JAMES, *Oxford, Ohio.*

Exploding fruits.—While out collecting recently I gathered a considerable quantity of Euphorbia serpyllifolia in fruit. Upon arriving home the plants were taken from the press for examination, as a fungus was detected upon the leaves. While attending to some other specimens I heard a strange little ticking sound which might be compared with the noise made by the little beetles often found in old furniture, known as "deathwatch beetles." Upon examination, it was found that the ripe capsules were bursting open and scattering their seeds in all directions. The capsules are not two lines long, yet the explosive power of their elastic valves is so great as to throw the seeds fully three feet away. Many of these bursting capsules were watched, and the average distance seeds were thrown was about two feet, sometimes a little less and often a good deal more.—F. W. ANDERSON, *Great Falls, Mont.*

Drying botanical specimens in sand.—This mode of drying specimens can not be called new, but, so far as I know, it is little practiced. Sometimes a botanist needs a faithful drawing of a plant as a whole, or in part. Perhaps he is too busy to make it at once, and may not have time to do it until the season of the plant is past. An herbarium specimen is not a satisfactory object for his purpose, and yet sometimes he must make it do. In the average case of this kind, the unfortunate victim of circumstances will find a sand-dried specimen to be as good for his purpose as the living plant. Suppose one wants to make a drawing of *Œnothera cæspitosa* Nutt., and can not find time for the work until the plant has been out of bloom a month. By faithfully following the directions offered he will have just what he needs: Take a tin can, or other vessel large enough to hold the specimen without cramping in the least degree. Place the specimen in the vessel in a natural position. Carefully sift into the vessel very fine, clean sand, previously warmed in an oven. Gently tap the outside of the can from time to time, in order to settle the sand slowly and evenly about the specimen. Sift in the sand until the specimen is completely covered. When this is done properly, every leaf is buried in its natural shape; even the delicate stamens and the more delicate petals are packed in the exact position in which they were developed. In removing the sand, after the specimen is dry, which takes from six hours to a week, according to its nature, great care must be exercised so as not to break the more fragile parts of the plant. To do the work nicely one should have a can made for the purpose. This need causes me to suggest the following device, which answers well. The size of this vessel will depend upon the individual requirements of the owner. It consists of a can with a funnel-shaped bottom, having the aperture closed with a screw-cap. It may be conveniently supported in a wooden frame. This is a simple contrivance and not expensive. If one so desires, a rubber tube may be attached to the outlet at the bottom, through which the sand may be run into some convenient receptacle and saved for future use.

Specimens dried by this method are not nearly so brittle as pressed ones; they retain their colors perfectly, as a usual thing, but they can not be recommended for the herbarium, because they take up too much valuable space.—F. W. Anderson, *Great Falls, Mont.*

EDITORIAL.

The discussion concerning botanical nomenclature is now fairly on and can do no harm. Mr. Britten, in the *Journal of Botany* (Sept.), has written at some length concerning "recent tendencies in American botanical nomenclature," taking for his text the recently published catalogue of New York plants, and, in the main, protesting against the proposed changes. Mr. E. E. Sterns, in the *Bulletin of the Torrey Club* (Sept.), puts very clearly the views of those advocating reform in nomenclature, and seeks to unmask opinion by proposing articles of agreement for signature, a sort of marshalling of the opposing forces. This might work in war, but is hardly practicable in mere questions of opinion. It smacks too much of the "stand-by-your-guns" principle, and does not leave enough of a loop-hole for some of us to crawl through and change sides when we want to be "converted and absorbed." The agreement proposed for signature practically settles the question for those who sign it, and announces that it is no longer open for discussion so far as they are concerned. The same, of course, would be true of any opposing agreement. We consider this, therefore, hardly the practicable way to begin a friendly discussion, in which one party is expected to eventually absorb the other, but simply a way to insure their never agreeing. It is suggested that the opposition to this reform may come from inertia, jealousy, or an honest difference of opinion. The first two, it is said, are so unworthy as "to be passed in silence," with which statement we heartily agree, and would even add that they are so unworthy that they should not even have been mentioned. One thing that will make the discussion confusing and lack directness of contact is the attempt to discuss more than one question at a time. It is our opinion that we could take the question as to the priority of genera as settled, as there seems to be no ground for argument in the case. It only becomes a question of certainty as to what the authors had in mind, and then as to publication. As to the rights of the specific appellation and manner of citing authorities, there may be honest differences of opinion; but the former question is so much more important than the latter that it may well be the only one considered at present. Proper citation of a name can only be considered after the name itself is settled. The absolute necessity of making a specific name permanent is not open to argument; it is only a question as to the best plan. It should also not be questioned as to our own procedure when we transfer a species to another genus; of course we should use the same specific name unless we find it preoccupied. It is a very different thing, as we look at it, to make a third combination, which can be referred to neither of the previous authors; but even in this we might be induced to vote with the majority if it did not involve the digging up of long buried and forgotten names to the utter confusion of the present fairly established names of many plants, and these forgotten names too often very uncertain of application. It has been our thought, therefore, in view of the well nigh hopeless task of discovering the meaning of even the majority of oldest specific names, that the simplest practice was to take the oldest combination of generic and specific names. To sum up, therefore, the old botanist (for we take for granted that the recent ones would not do it) who transferred a species and changed its specific name should not have done it (if he knew of the existence of the former name); but, having done it, the name stands. We do not write this to express our readiness to sign an agreement in opposition to that referred to, for we still want to remain open to conviction.

OPEN LETTERS.

Peloria of Linaria vulgaris.

I had, to-day, the most extraordinary confirmation of the idea sometimes cherished, that when the mind is charged with a particular notion the subject is not far to seek. Passing near a lot covered over with Linaria vulgaris in full bloom I said, "Now is my chance for peloria!" Sure enough, though the incredulous may smile, at my very feet was a bed of twenty or more plants, all showing it, and in most fanciful ways. I have in other seasons occasionally met with a single flower so reverted at the top of a stem, but here were flowers with five spurs, some with three, some with two, and others normal, all on the same stems; this, too, shown by many distinct plants. All the peloric blossoms examined show an andrœcium of five stamens, irrespective of the number of spurs. There are, also, five lobes to the corolla in each case. Some of the flowers are disposed in whorls, these nearest the top of the stem, as if the raceme were breaking up. The number of spurs decreases in acropetal order. In one flower fasciation is shown as well as peloria; the result is a corolla of two *double* spurs, a corrugated palate, an upper lip of four lobes, and a lower of six lobes. It is especially to be noted, in view of the "supply of energy" theory, that these flowers are all along the stems, not necessarily at the top, and that the lowest of flowers, as a rule, are most peloric. Gray's Manual states that Dr. Darlington observed the peloric state of Linaria vulgaris in Pennsylvania. For real good Yankee eccentricity, Rhode Island is, as ever, ahead.

Providence, R. I. W. W. BAILEY.

Botanical papers at the A. A. A. S.

Referring to the biological section of the American Association, the GAZETTE remarks: "Very little can be claimed, however, for the quality of the botanical papers. With some exceptions, they showed a narrowness of observation and a superficiality of study which were lamentable." As the only papers these can possibly refer to, from the synopsis given in the GAZETTE (the others being commended, or only read by title or brief abstract) were Professor Sturtevant's, Professor Schrenk's, Professor Halsted's, Professor Beal's, or Mr. Meehan's, and as the editorial notes show which papers the "cap" is intended "to fit," I trust you will allow me to remark that I should feel no right to object to this decision of the editors of the GAZETTE if I felt that my papers were understood by those who listened to them. Indeed, I do not now object to your decision, but simply desire to ask the reader to compare the abstracts as given, with the notes of what the objectors said in proving the point that the essays must have been misunderstood.

I had no other object in presenting the papers than to contribute to the interest of the meeting, and I can only say, in regard to the quality of the entertainment offered, as Dr. Gray once said when told that a brother botanist had declared that he could "get out a better manual" than the doctor had done, "He is the man I want to see. By all means, let him bring his manual out." No one will be more pleased with better papers than I.

Having, however, the above thought of temporary interest only in view, I had no idea of publishing my papers in the form in which they were then presented; but in view of the sharp, and perhaps just, criticism of the editors of the GAZETTE, it will only be fair to myself that I take the benefit of the doubt, and lay them in full before my fellow students, and I hope before long to find some opportunity of doing so.

Germantown, Pa. THOMAS MEEHAN.

[The GAZETTE'S criticism was not directed wholly to Mr. Meehan's papers, as he assumes. Much less were any papers judged by the amount of "entertainment" or "temporary interest" they afforded. The criticism was aimed wholly at their character as *scientific* productions, as which, it is to be assumed, they are presented.—EDS.]

CURRENT LITERATURE.

Origin of our Trees.

Paleobotany, founded by Adolphe Brongniart, is a subject of great and increasing interest. The difficulties with which it has to contend are enormous, and its growth necessarily slow, but a few years has brought much information, and paleobotanists are to be commended for their great activity. Eminent among the multiplying workers is Count Saporta, whose last work[1] is before us, on the origin of trees cultivated or used by man. The text is interspersed with 44 excellent figures, and the whole treatment of the subject is remarkably clear. Of course it would be impossible in this brief sketch to give any detailed account of a book which is entirely made up of details, but a brief synopsis of contents will serve. The subject proper begins with a discussion of the various groups of gymnosperms; in the second division the monocotyledons are considered, with such forms as the palms and smilax; the third and largest division is devoted to dicotyledons, its many arborescent orders being taken up in succession. The figures are very suggestive, and being usually labelled as the ancestral forms of familiar modern groups, at once catch the attention of a botanist. One of the most excellent features of the book is a synoptical table, which gives in a condensed form, arranged according to geological chronology, the beginnings of the various groups. By this means a glance will catch facts which otherwise would demand much reading for their discovery, and probably would be lost sight of entirely unless the reader was very conversant with French. For instance, one sees that the Carboniferous has given the first indication of the existence of Cycads, the primitive Salisburias, etc., while the type Salisburia, or Ginkgo, is not established until the Permian. In the upper Trias we find the ancestors of the Cupressineæ; while in the lowest member of the Cretaceous the first dicotyledons are discovered, and possibly the genus Populus, an appearance which is speedily followed in the upper Cretaceous (Cenomanian) by a great abundance of dicotyledonous types. This simply serves to illustrate the great amount of information that can be obtained from a table which seems to be packed with details. We commend this book to all botanists interested in the subject, as one which will give them a vast amount of accurate information upon a subject whose literature is widely scattered or hard to obtain.

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[1] SAPORTA, LE MARQUIS G.—Origin paléontologique des arbres cultivés ou utilisés par l'homme. Pp. xvi. 360. Paris: J. B. Baillière et fils, 1888. Price 3 fr. 50c.

A Monograph of the Lotus.

Dennert, who completed and edited this posthumous monograph,[2] tells us that Wigand was well known to be an energetic adherent and defender of the doctrine of the fixity of species. He hoped to secure, through the work of his students and others, a series of exhaustive monographs, not only of families and genera, but also of species, in which every character of the plant should be set forth. From such a series of works upon nearly related plants, he hoped to be able to draw important conclusions regarding the value of specific characters, the relations of variation, and particularly to obtain an exact definition of the term "species." As an indication of the sort of work which he wished, he undertook this monograph on a most interesting plant, the famed Lotus. But the work was interrupted and left incomplete at the author's death, and Dr. Dennert, assistant in the botanical institute at Marburg, added the anatomy of the nodes, the leaf blade and its origin from the petiole, etc. The paper discusses the morphology, development and anatomy of every part of the plant, and concludes with biological remarks on the starch in the leaves and rhizome, and on the vegetative and resting conditions of the rhizome. From this it will be seen how wide is the scope of the monograph. Its execution is admirable and the paper may well be taken as the model it was intended to be. This is the exhaustive style of work to which we have exhorted American botanists.

Minor Notices.

THE INSECT RELATIONS of flowers receives a fresh contribution from Mr. L. H. Pammel, who writes of the pollination of Phlomis tuberosa, and the perforation of flowers by insects.[3] Phlomis tuberosa is compared with P. Russeliana, of whose pollination an account is given by Loew, and which it much resembles. On the perforation of flowers Mr. Pammel has collected much widely scattered literature, both on the direct subject and several related ones. The paper is accompanied by a very full bibliography, and will certainly be of much service to students in this field.

PROFESSOR JOHN MACOUN has just distributed the "Endogens" of his catalogue of Canadian plants.[4] Any one familiar with the other parts understands the painstaking work this represents. The detailed enumeration of stations can not but be of vast help, not only to collectors, but in the study of geographical distribution as well. Professor Macoun has availed himself of all possible help from specialists, so that the catalogue contains the most recent changes in nomenclature. This part brings the genera to 737 and the species to 2955.

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[2] WIGAND, ALBERT.—Nelubium speciosum W., eine monographische Studie, vollendet u. herausg. von E. Dennert. (Bibliotheca botanica, heft 11), pp. 67. pl. vi. 4to. Cassel Theodor Fischer. 1888. M. 12.

[3] PAMMEL, L. H.—On the pollination of *Phlomis tuberosa* L., and the perforation of flowers (Contributions from the Shaw School of Botany, no. 1). Pp. 241-277. pl. vi and vii. 8vo. Separate print from the Trans. St. Louis Acad. Sci., vol. v. St. Louis, June 28, 1888.

[4] MACOUN, JOHN.—Catalogue of Canadian Plants. Part IV.—Endogens. (Geol. and Nat. Hist. Survey of Canada.) 248 pp. Montreal: Dawson Bros., 1888.

THE LONG HOPED for continuation of Professor Tuckerman's Synopsis of N. Am. Lichens has appeared, under the editorship of Mr. Henry Willey.[5] The work could not have fallen into more competent hands. This second part was found in a sufficient state of preparation to justify publication, and very little revision has been necessary. The presentation of the large genera Biatora, Lecidea and Buellia will be a great help to our amateur lichen students, large parts of whose collections were very indefinitely named. The genus Graphis is incomplete, but sixteen species being included in this part. Mr. Willey has done good service also in adding, in the form of an appendix, descriptions of N. Am. lichens not found in the Synopsis, but published by Professor Tuckerman in scattered publications which are not easily obtained.

"HOW TO STUDY BOTANY" is the title of a very interesting paper by Dr. T. J. W. Burgess, of Hamilton, Ontario, read before the Hamilton Association.

THE MEDICAL plants of the United States have attracted attention from Rafinesque down. The most recent contribution to this subject is by Dr. Carter,[6] of Waukegan, Ill. The list is a very long one (over 300 species), but only includes those plants whose medicinal properties are definitely known. The work has been carefully done, and forms a very compact reference book for information of that kind.

THE PLANTS of Nantucket are published by Maria L. Owen in a very carefully prepared catalogue.[7] Nantucket county means practically Nantucket Island, and the enumeration shows 586 species of phanerogams exclusive of varieties. Pteridophytes and algæ are also catalogued. The names of the botanists who have assisted the author are numerous and well known, and we may be sure that the catalogue represents a very accurate and exhaustive account of the flora of this island of fifty square miles.

MISS HELEN C. DE S. ABBOTT is a very active worker in the comparative chemistry of plants, and her paper on "Comparative chemistry of higher and lower plants," in the *Am. Naturalist* for August and September, 1887, has just been distributed as a reprint.

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[5] TUCKERMAN, EDWARD.—A Synopsis of the North American Lichens: Part II., comprising the Lecideacei, and (in part) the Graphidacei. 76 pp. Sold by Edwin Nelson, Amherst, Mass., at $1.

[6] CARTER, J. M. G., M. D.—A Synopsis of the Medical Botany of the United States. Pp. x. 176. St Louis: Geo. H. Field, 1888.

[7] OWEN, MARIA L.—A catalogue of plants, growing without cultivation, in the county of Nantucket, Mass. Pp. xii. 87. Northampton, Mass., 1888.

AN ELABORATE study of the structure, development and affinities of Trapella, a new genus of Pedalineæ, is presented by F. W. Oliver in the *Annals of Botany* (June), and now distributed as a reprint. It is a Chinese plant of doubtful affinity, but this study rests it in Pedalineæ, as the only genus of a new tribe. It contains certain structures of great interest biologically. The five handsome double-page plates form a fitting accompaniment to a very fine piece of work.

ONE of the best local catalogues we have seen is that of Middlesex county, Mass., prepared by Messrs. Dame and Collins.[8] Not only is it printed with great care, but contains just the information one desires. In addition to the usual presentation of phanerogams and pteridophytes, it contains the mosses, liverworts, stoneworts, algæ and lichens. Dealing with an old country and one full of collectors, the list must be a very complete one. The summary shows an enumeration of 2061 species, 1,484 of which are phanerogams, 60 pteridophytes, 156 bryophytes and 361 thallophytes. In a private letter the authors say that the name of Mr. L. C. Martindale was inadvertently omitted from the list of those who had aided in the work.

NOTES AND NEWS.

IN A RECENT fire the Syracuse Botanical Club lost all of its collections, books and instruments.

MR. LESTER F. WARD's address on "Asa Gray and Darwinism" has just been distributed.

DR. G. F. KOHL, *privat-docent* in Marburg, became associated with Dr. Uhlworm in editing the *Botanisches Centralblatt* on the first of August last.

MR. F. W. ANDERSON, of Great Falls, Montana, has been appointed a special agent in the Division of Botany of the Agricultural Department.

THE *Journal* of the Elisha Mitchell Scientific Society, in its first part for 1888, contains a preliminary list of North Carolina Desmids by W. L. Poteat.

THE ILLUSTRATIONS of our native plants in *Garden and Forest* for August include Cypripedium Californicum (8th), and Erythronium Hendersoni (29th).

M. L. MOROT (in *Journ. de botanique*) shows that the anatomical structures of the anomalous Adoxa Moschatellina are more suggestive of Saxifragaceæ than of Caprifoliaceæ.

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[8] DAME, L. L., and COLLINS, F. S.—Flora of Middlesex county, Mass. Pp. 201, with map. Malden: Middlesex Institute. 1888.

Reports from the recently established agricultural experiment stations are beginning to come in rapidly. We have before us various kinds of reports from Indiana, Michigan, Illinois and Iowa.

Dr. Bessey (*Am. Naturalist*, June) suggests that the development of chlorophyll-bearing tissue in young fruit is for the nutrition of the embryo in the seed, and remarks that this is an important but overlooked function.

The large and important collection of fungi belonging to the late Dr. G. Winter has been purchased by the Botanical Museum in Berlin. It is well that this valuable herbarium is to be kept together and be accessible to students.

Proliferous strawberries are not so common, and the *Gardener's Chronicle* (August 18) figures one that has three or four buds from the sides, one of them so fully organized as to have leaves, adventitious roots, a beginning runner and a terminal flower.

Prof. W. W. Bailey reports finding recently a fully-doubled Aster, all the disk florets changed into ligulate ones, between Lake Oskawana and Garrison's, N. Y., near Cowpens Mt. The species is probably A. macrophyllus. All the heads on the plant were so doubled.

Dr. Joseph Schrenk gives, in the *Druggists' Bulletin* for August, two papers, entitled "Pharmacognostical notes on the bark of Sycocarpus Rusbyi," and "Pharmacognostical notes on the bark of Newbouldia lævis." The papers are illustrated by two admirable figures.

Our knowledge of the plants of the interior of China is rapidly advancing, judging by the rate at which lists and new species are being published. In the *Journal of Botany* (August) Dr. J. G. Baker catalogues two recent collections of ferns, among which are described sixteen new species.

In looking over Schimper's herbarium at Kew, Mrs. E. G. Britton has discovered a specimen of Ulota phyllantha, labelled in Schimper's own handwriting, "Muckross, Killarney, Hibern.," which bears five capsules. The specimen was collected in 1865. This is a lesson to bryologists to look out always for fruit, even on specimens of species usually sterile.

The annual report (for 1887) of the Royal Botanic Gardens at Trinidad has been distributed by their very efficient superintendent, Mr. J. H. Hart. A summary is given of the history of the garden and its present condition. The photographic illustrations are especially interesting, giving one a notion of the beauty and plan of the gardens better than any text.

The last two parts of the seventh volume of the *Annales des Sciences Naturelles* (*Botanique*) are almost entirely devoted to an elaborate paper by M. Courchet on chromoleucites. He discusses their development, structure and form, the relation between the color of a pigment and the form in which it exists, and finally details a special study of the pigments contained in the chromoleucites or produced by the leucites. The memoir gives a host of details, and evinces an extraordinary amount of work. It does not, however, present any essentially new principles, and agrees, in the main, with Schimper's well-known contributions on these and allied structures.

Mr. C. E. Overton has watched the conjugation of Spirogyra, and finds that the conjugating tubes grow toward each other at the rate of 3μ per hour, and that twenty four hours elapses between their contact and the complete solution of the wall. The passing over of the contents from the male cell usually begins about ten or eleven o'clock at night.

The new genus of Palms (Bot. Gazette, xi, 314) from the Florida Keys, brought to light by Dr. C. S. Sargent and dedicated to him, is figured in *Garden and Forest* (September 19), where the completed generic characters are also presented. Ripe seed was obtained last year by Mr. Curtiss, and Dr. Wendland has thus been able to establish his Pseudophœnix Sargenti.

In the September *Amer. Jour. Sci.* there appears as an appendix a list of the writings of Dr. Gray, chronologically arranged. The work has been done by Drs. Goodale and Watson, assisted by Professors Farlow and C. S. Sargent, and a glance through these forty pages of fine print not only shows the great labor involved in its preparation, but also what an enormously prolific writer Dr. Gray was. Beginning with two numbers in 1834, one on mineralogy and the other the N. Am. Gramineæ and Cyperaceæ (exsiccatæ), and ending with 1888, no year is unrepresented in his writings, excepting 1839 and 1869, and even these contain editorial work. No less than 355 numbers are credited to him, besides the uncounted number of botanical notices and book reviews.

The memorial of Asa Gray at the American Academy of Arts and Sciences has been distributed and should be in the hands of every American botanist. The resolutions were offered by the president, Prof. Joseph Lovering, and seconded in a short address by Mr. Augustus Lowell. President Eliot then spoke briefly of his relations to Harvard University. The chief interest centers about the addresses of his botanical associates, those men who did not know him afar off, but were in daily contact with him Dr. Goodale spoke chiefly of him as an instructor, in the lecture room and through his books. Dr. Watson naturally had to deal with his relations to the great herbarium which bears his name; while to Dr. Farlow fell the more onerous duty of preparing a biographical sketch. When it is said that all of these addresses were worthy of the man they had met to honor no higher commendation is needed.

F Went has in the last part of Pringsheim's *Jahrbücher für wissenschaftliche Botanik* (vol. xix, pp. 295-356) an exceedingly important paper on vacuoles. His conclusions, in his own words, are as follows: With the exception of the doubtful spermatozoids, Cyanophyceæ, and Bacteria, all living cells contain vacuoles which are surrounded by a special living wall which bears the name of "tonoplast." In all young cells division and coalescence of vacuoles takes place. All normal vacuoles of a plant arise through continual division from those of the oosphere. The tonoplasts, considered as organs of the protoplasm, are of equivalent origin with the nuclei and chromatophores. Since the vacuoles, even in the youngest cells, are continually altering their shape, protoplasmic movement must take place in them, and does not begin, as Hofmeister thought, only after the meristematic state is past. Normal vacuoles never arise from the protoplasm. Pathological vacuoles are formed by the disorganization of the nuclei and chromatophores. The paper concludes with a summary of the present knowledge in regard to the vacuoles.

VOL. XIII. NO. 11.—BOTANICAL GAZETTE.—NOV., 1888.

Development of cork-wings on certain trees. II.

EMILY L. GREGORY.

ACER CAMPESTRE LINN.

Two kinds of Acer were examined, one, A. campestre, conspicuously winged till the stem is three or four years old, the other, *A. monspessulanum* Linn., much less, though the early part of its periderm formation is very similar to that of A. campestre. The development differs in both cases from that of Quercus, sufficiently, perhaps, to warrant a brief description.

Of Acer campestre, the young stem is six-angled, the periderm forms uniformly around this, by the cells of the first layer of primary rind becoming phellogen and developing centripetally[13] just as in case of Quercus. The breaking takes place along the six angles, the subsequently increased rapidity of growth under these fissures occurs, but with this difference, there is no line of distinction between the cells of the periderm formed previous to the splitting along the angles, and those of the wing formed by the renewed energy of the phellogen under these fissures. Instead of five, as in Quercus, there are six longitudinal bands growing faster than the remaining six; this continues till a furrow is formed along the top of each wing, making a similar shell-shaped appearance on the cross section as in Quercus. (See fig. 11.) Now very early in the development of the wing, the cells of the remaining six bands begin to grow and increase more rapidly than those of the former six, thus the central portion of each furrow is forced out until the edge of the wing is perfectly straight, in most instances no signs of the furrow being left. There is now no difference in the appearance of the cells of the entire wing. Toward the end of the summer, or the beginning of the fall growth, there are six strongly developed wings, the clefts between each two successive ones reaching quite down to the phellogen layer. The cells of the remaining epidermis have been so protected by this breaking in fissures and subsequent curling up, that not unfrequently the hairs from this tissue are seen along the smooth surface of the wing. This is shown in figure 11.*a*. As the autumn growth begins, several layers of narrow plate cells are formed entirely around the stem and it now takes its winter's rest. In the following spring, the manner of growth seems to vary. In most stems examined the process was quite similar to that of Quercus, the entire zone of phellogen cells developing rapidly till the protecting band of thicker walled plate cells breaks at the fissures and the new growth forces outward the last year's wings. This rarely, if ever, continued longer than till the third year; the growth of the three years' stems, as well as many of the two years', being as follows: As the girdle of plate cells breaks, the increased growth in circumference of the entire rind cells appears to take place most rapidly in sections under the fissures, or between the wings of the first or second year's growth. The periderm cells are formed more or less uniformly, but the foundations are laid for new wings between those already formed. In this way six more wings are formed, and not many seasons after this, the stem assumes the ordinary ridged and furrowed appearance which is no longer described as winged. Thus the transition from wings to ordinary furrowed periderm takes place. This method of transition is carried still further in

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[13] Centripetal is used here as by Sanio, in the sense that the newest tangential wall is nearest the center of the stem.

ACER MONSPESSULANUM L.

The stems of the second and third year of this species can hardly be called winged, though the periderm growth oi the first year corresponds to that of Acer campestre. That of the second year is similar to the third and fourth of the stems of the former. Little wings are formed between those of the first year so rapidly that a fissure occurs along the edges of these during their first year's growth; that is the second year of the stem. (See fig. 14.*f*.) The result of the repetition of this process is the formation of a periderm around the older branches with rather shallow and irregular furrows and by no means prominent ridges. This species thus may be considered a transition form between the regular cork wings of A. campestre and the comparatively smooth periderm on the young branches of the common maple.

LIQUIDAMBAR STYRACIFLUA L.

The cork wings found on this tree have one striking peculiarity which renders them an exception to all other cases examined. This is their eccentric or one-sided origin and growth. In this respect the species seems to stand quite alone. The specimens examined in the summer of 1887 were taken from trees of various ages and places of growth, all of them were under cultivation and all in the vicinity of Philadelphia, except those from the Arnold arboretum. In the summer of 1888, examples were obtained from trees of different ages growing wild near Woodbury, N. J. The results obtained from these, while confirming in most respects those obtained from the specimens of the previous year, were much more satisfactory, as the young tree in its early stages, up to those of fifteen years old, could be observed under natural conditions. The wings of the lateral branches appear always on the upper side, running along between the leaves, two, three and sometimes four in number. They generally stand at such an angle as to form troughs along the entire length of the branches. These are, of course, interrupted at the nodes by the leaf-petioles, but they slope gradually toward each other, so that the effect of a continuous trough is often produced. The main trunk is entirely surrounded by deep ridges and furrows along that part free from branches, and extending up perhaps half way through the crown of the tree. Above this a smooth periderm appears. A large number of specimens were studied, with a view of discovering the cause of the one-sided growth on the lateral branches.

The principal results of the anatomical study may be given in few words.

The first appearance of periderm formation occurs early in the year, but in most cases the youngest internodes of the year's growth are covered only by epidermis. The phellogen cells are in this case the second layer from the epidermis, so there is one layer of rind cells cut off, as de Bary says of a similar case, without wings, "for a very small bark." Lenticels are developed with this first periderm in considerable numbers. On the lateral branches at the time of the beginning of the cork wings, they are much larger, better developed and somewhat more numerous on the upper than on the under side of the stem. With this exception, the growth appears perfectly normal, a periderm of several layers is developed around the stem with lenticels connecting the rind cells with the outer air. After a time, along the upper side of the older internodes of this year's stems may be noticed an increase in the tissue around the lenticels. This may be easily identified by the naked eye as cork tissue from its color, which is slightly reddish, and different from the rest of the surface. This is the first beginning of the wing: the tissue soon spreads from one lenticel to another until a ridge is seen extending along the upper surface of the internode. It is not possible to say that the wing always takes its rise from the lenticels, in this way, as instances of its origin between the lenticels, then spreading out so as to include them afterward, may have been overlooked. No such cork tissues were found entirely disconnected from the lenticels. Another fact pointing to the lenticellular origin of the wing is, there were several examples, where, for some lack of favorable conditions, the wing formation had stopped with the growth of cork immediately under the lenticels in such a manner that a number of these, lying in almost a straight line on the upper side of several successive internodes, were raised up from the surface for a distance of one or two millimeters. Usually there was only one ridge of cork at first: often, however, there were several smaller ones branching off, so that when developed a number of wings stood out at different angles.

The manner of growth of this tissue does not differ essentially from that of the previously described type. The phellogen layer in the vicinity of the lenticels becomes endued with unusual vitality; cells are cut off centripetally, and by this means the lenticel is raised up or away from the rind, a large number of cork cells intervening between it and the rind-cells. The opening of the lenticel now takes the place of the fissure made over the corner of the angular stem of Quercus and Acer above described. As the epidermis is raised up along the band, the longitudinal fissures already existing in the lenticels spread from one to the other until a continuous cleft is made along the whole internode. In this way are laid the foundations for two wings, which appear to be the normal number. In many cases, however, the development about each lenticel takes place in such a manner that instead of one connected line along the internode, several are formed; these often join each other at different points so that closed furrows are formed, the number of ridges, or wings, thus being increased to three, four, and even five; in the last case they nearly encircle the stem.

In those wings breaking along the openings of the lenticels, which have been described as normal, there occurs also another break which separates the wing from the remaining tissues. This is a break along the edges of the band of corky tissue where it joins the regular periderm. This is shown in fig. 15, *b*. This breaking is prevented at first by the cells along these lines forming new walls at such angles as to form a fan-like spreading, large enough to accommodate the rapidly growing wing. The rapidity of growth, at first greater in the center of the wing, appears to gravitate toward the edges, and the break occurs. Both sections of the wing are now free to be shoved out by the rapidly growing phellogen. In the meantime the fissure in the middle, originating from the lenticel opening, increases till it reaches in many cases quite down to the primary rind. Toward the fall, about the middle of September in the examples studied, there are formed several layers of plate cells, extending around the whole stem. When growth is resumed in the following spring, the formation of cork is limited strictly to the phellogen under the wings; its rapid growth breaks the bands of plate cells and new layers are formed, pushing outward the growth of the previous year. As long as the vitality remains principally in the phellogen cells under the wings, this process is repeated each year; the breaking which takes place on renewed growth in the spring follows the lines already started, and the age of the stem may be estimated as surely by the number of broken bands of plate-cells along the edge of the wing, as by the number of woody rings on the other side of the cambium ring. The material for this study was very abundant, and a large number of specimens was examined; among them all was only one case in which the number of annual layers of cork did not agree with the number of woody layers of the stem. In this instance six rings of cork were found, where only three of wood could with certainty be detected. It is impossible to say, in this case, whether two rings of cork had been added each year, or whether the annual marking off of the wood had failed in the later years of growth, as the last ring of wood which was plainly marked off was about the width of both the other two. On many branches whose woody growth is not very rapid, these cork wings reach a comparatively enormous size, often measuring in depth twice and three times as much as the diameter of the remaining part of the stem. Some have been found fully three centimeters in depth, and one and a half centimeters is not an uncommon size. These large wings, when found on lateral branches, occur in most cases on stems which have closed their growth in length. Those stems whose growth in length is prolonged from year to year till they form the main branches of the crown, begin, when young, to develop wings in the ordinary manner, and continue doing so for six or eight years. Then on the older internodes the development under the wings becomes less and less in amount; the ordinary periderm accommodates itself to the increasing size of the surface of the other parts of the stem, that under the wings apparently remaining stationary, until it is highly probable in many cases the growth of the wing entirely ceases and the phellogen of the entire circumference resumes its function of uniform growth, and the wings are slowly cracked off. However this may be, many of the larger stems appear to be covered with a nearly smooth periderm, and many others are nearly smooth at the place where they join the main trunk, while further on toward their extremities they are profusely covered with wings.

Now taking the growth of the main stem from its origin, a young tree, three years old, was cut off about one and a half feet from the ground. At this height the circumference was nearly covered with the cork wings, but by looking carefully it could be seen there was still a distinct longitudinal strip or band which was yet free from this growth except under the lenticels. This was more and more easily traced as one looked upward, until the last year's shoot which showed the typical one-sided formation. So with the oldest internodes of this year's growth; date, July 16. The whole length of this year's growth of main stem was forty-six centimeters; the lower thirteen centimeters had well-developed cork wings, above this none had yet appeared. Lateral branches growing out from this portion of the main stem were also supplied with wings on their older internodes. It is easy to see how the whole bole of the tree probably becomes covered with its ridged and furrowed periderm. In the tree just described, the longitudinal strip or band along which ran no regular wings was already supplied with corky tissue at the lenticels, raising these slightly from the surface. The phellogen cells of this tissue probably soon after the third or fourth year become endowed with special activity; the layer is extended from lenticel to lenticel, just as in the first year's growth, till at last connected ridges are formed, more or less irregular in their course, as the lenticels have no regular order of arrangement. These ridges assume, after a few years, an appearance entirely similar to those of the first year's growth. In fact, intermediate stages appeared already present where the lenticels appeared in certain stages, leading to the final result of covering the whole trunk of the tree. Ridges from a tree of fifteen years were broken off about four feet from the ground. The annual deposition of corky substance was seen here to diminish as the tree grows older, the later years' rings being much narrower than the earlier ones.

Biological Dep't, Univ. of Penn.

Botany at the University of Göttingen.

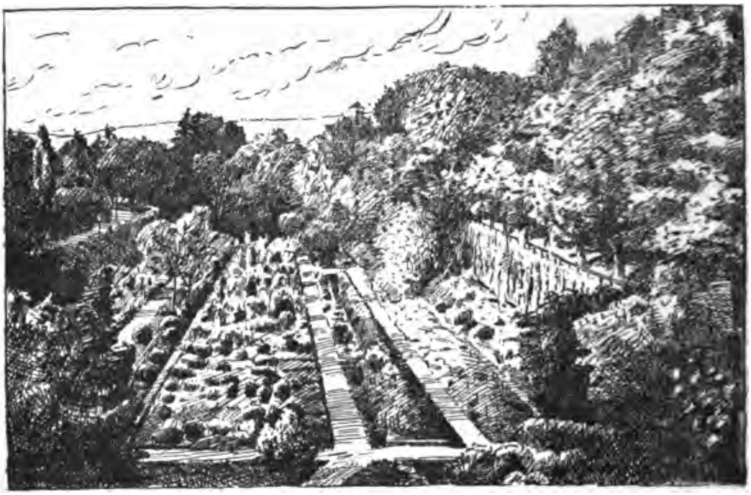
W. E. STONE.

The botanical department of the University at Göttingen, of which I have been requested to write a description, has never been particularly famous, yet has won and retained an excellent reputation in Germany for its good work and favorable advantages. Persons whose experience warrants the expression. of an opinion, consider the arrangement of the laboratory to be equalled by few others in Europe, while the garden is notably well stocked and cared for. For the latter much credit is due Prof. Graf zu Solms Laubach, who for many years was director of the same and professor of systematic botany. In the spring of the present year he received almost simultaneous calls to the Universities at Strasburg and Berlin, accepted the former, and now occupies the chair of deBary.

There is a tacit division of the work here into the physiological and systematic departments, each presided over by different professors, and each with its own laboratory, branch library and lecture room.

The present director of the garden and professor of systematic botany is Dr. Peters, formerly a student and assistant with Nägeli. His work upon the genus Hieracium has secured him special notice. He was called to Göttingen from Munich, to take the place of Prof. Solms Laubach.

The garden, which is one of the sights of the not remarkably interesting old town, occupies, roughly estimated, five or six acres of ground, lying partly within and partly without the old "wall." The latter is no longer the defense for which it was planned and built some three or four hundred years ago, but has become a pleasant elevated promenade with grassy slopes and planted with a double row of fine old lindens, beneath which one always meets a procession of promenaders on pleasant summer afternoons and evenings. For a part of its winding course, as I have said, it traverses the botanical garden, looking down to the south side upon the dwelling of the director and gardener, the green-houses and the collections of tender plants, thus protected from the cold north and east winds. On the other, the north side, are the more extensive collections of hardy plants, trees and shrubs, arranged to some extent systematically, especially the herbaceous plants. The principal entrance to the garden is from one of the streets of the inner town. Passing the pleasant old-fashioned houses of Director Peters and the gardener, one comes out upon a fine lawn fronting the three large green-houses, behind which rises the sheltering "wall." Close beside the director's house a large three-story brick building is rising, which, when the slow-but-sure German building process shall be completed, will serve for a "systematic" laboratory, herbarium, and auditorium. Upon the lawn are grouped in summer the potted shrubs and hardier plants from the green-house, tree ferns and palms, giving the little space a decided tropical aspect. Here, too, is an excellent collection of Azaleas, and near by in a shady, moist nook are the native orchids.



BOTANICAL GARDEN AT GÖTTINGEN.

Two tunnels pierce the "wall" and bring one out on the other side into a different flora—that of the temperate zone. In the foreground runs a little stream, moistening a bit of meadow turf and supplying a basin for aquatic and marsh plants. Behind this rise low terraces neatly and systematically laid out in beds for herbaceous plants, where naturally the Compositæ preponderate. On the west side of this part of the garden stands the finest building of the University, from the upper windows of which the view given here is taken. Toward the east rise masses of trees, behind which, with an entrance from the street, stands the physiological-botanical laboratory. Still farther toward the east are open spaces devoted to the collections of grasses and sedges, the Liliaceæ, Araceæ, etc.

Altogether the garden, partly from natural location, partly from the influence of the "wall," furnishes a remarkable variety of exposure and adaptation rarely met with upon so small an area. I have seen no botanical garden better kept than this; there are absolutely no waste spots, although spontaneous natural growths are allowed in some places.

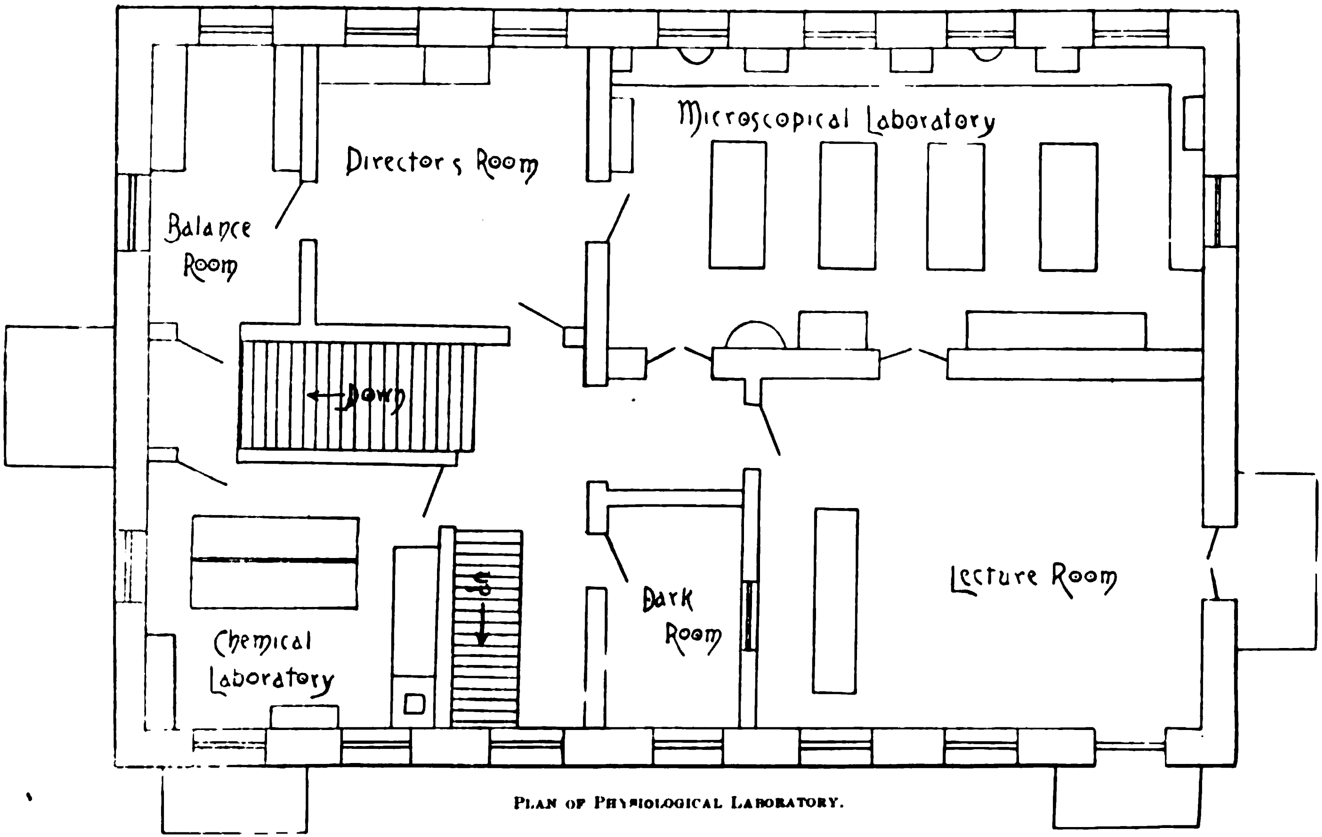
The herbarium is said to be a good collection, but, as is often the case in these days, lacks attention, and is simply stored away in the upper story of one of the garden buildings, inaccessible and unused. The intention is, however, to have it properly arranged and made available in the new building being erected. The physiological laboratory is under the direction of Prof. G. Berthold, one of the youngest full professors in the University, his early promotion being the recognition of his energy and ability. His career was begun here as "privat docent"; afterwards he was assistant to the director of the zoölogical station at Naples, where he published several monographs on the marine algæ. He became "ausserordentlicher" professor at the university of Göttingen in 1885, and full or "ordentlicher" professor in 1887. His principal work, aside from numerous contributions to journals, has been "Studien über Protoplasma Mechanik," a profound production published in 1887. Prof. Berthold's relations to his students are of the most pleasant nature. He is a hard worker, taking short vacations, and almost invariably to be found during working hours in his private laboratory, from whence at short intervals he visits his students working in the main laboratory, greeting each with some pleasant word of advice and encouragement. The assistant, Dr. Koch, with whom the students come directly in contact, was a pupil and assistant of deBary. His greatest horror is untidiness, of which fact no student is likely to remain long unacquainted.

My two years' connection with these men leaves me with a lively and grateful appreciation of their worth as friends and teachers which I can not omit expressing here.

The physiological laboratory is a very substantial two-story stone building with rather plain exterior. The view given is taken from the south or garden side. The ground floor is occupied in part by the janitor's family, a common custom in the University buildings, and by a museum, physical cabinet and physiological laboratory. There is also a workroom on this floor containing a still, forge and table for glass blowing. In the cellar are rooms for gas analysis, temperature experiments, etc. The main working rooms of the laboratory are on the second floor, a plan of which is here given.

LABORATORY FOR VEGETABLE PHYSIOLOGY.

The main rooms are directly accessible from the stair landing. First on the left is the director's private laboratory with its independent outfit, working table before one of the windows, water, gas, ventilating hood, aquaria, etc. A door opens into the main laboratory, a large, well lighted room with five windows of 4½ by 8½ feet dimensions, looking out toward the north and east, and affording a fine illumination for microscopic work. There are places here for thirty students, ten for advanced workers directly before the win-



PLAN OF PHYSIOLOGICAL LABORATORY.

dows at benches provided with drawers, closets, cases, reagents, water and gas. Twenty more students, engaged with simpler work, find places at four large tables arranged through the middle of the room. A cabinet for microscopes, a case for reference books, shelves for specimens, a "*Brutofen*" for the reception of cultures, completes the furnishing of the room. Adjoining, on the south side of the room, is the auditorium, which, as a lecture room, accommodates fifty hearers, or by removal of the portable benches can be used for experimental purposes. Two of these windows are really glass doors opening to the east and south into glass-covered balconies used for the reception and cultivation of plants for lecture demonstration. In the southern one is a small glass forcing house, or more properly box, capable of being heated by gas, and provided with a thermo-regulator. The lecture table is also arranged as an experimental table and provided with gas, water and an air-pump. The room may be effectually darkened for experiments with light. In this connection the sliding black-board behind the table reveals an opening into the "dark room" well supplied with optical apparatus, by means of which light of varying quality may be transmitted to the experimental room. This arrangement also allows the most convenient use of the stereopticon for class demonstration. The remainder of the south side of this floor is occupied by the chemical laboratory with complete apparatus and accommodations for four workers, with water, gas, steam drying bath, sink, two large hoods, combustion furnace, muffle, etc. Here again a glass door opens upon a glass-covered balcony for the reception of plants under observation. From this a second balcony is entered, which, thus cut off from the remainder of the building, is used for the generation of noxious gases.

From the chemical laboratory a gallery leads over the stairway to the balance room; from it a side door also opens upon a large open balcony over the entrance to the building, with a western exposure—a convenient place for growing and maintaining potted plants in summer.

The balance room is supplied with a fine Sartorius' chemical balance, and a large balance for the reception of growing plants weighing from 0.1 to 15,000 grams. The same room contains the reference library, and is also accessible from the director's room.

From the landing another staircase leads to a physiological work-room under the skylight, and there are one or two store-rooms also on this floor. Last, but not least, is a small work-shop for the janitor, who is an excellent mechanic and makes nearly all the apparatus and models required in the institute.

A noteworthy feature is the double water supply, two complete systems of pipes leading to all points of the building, one for the city water, which contains so much lime that it is unfit for general laboratory use, and one for rain-water, collected from the roof and stored in a reservoir on the third floor. The systems are interchangeable, and both may be used for either rain or "city" water.

The building is new, having been first occupied in 1879, and was intended to embody the best features of the best botanical laboratories known at the time. A full discription of its plan and erection is given in the *Botanisches Centralblatt*, V. (1881) pp. 318, 349, 388.

In this, as in most of the German universities, the greater part of the botanical students are derived from the medical and pharmaceutical departments, a knowledge of botany being required in the examinations in both these branches. For these students lectures and work of a general nature are provided, but there were always, during my acquaintance with the department, a comfortable number of advanced students engaged on theses and "arbeits."

I give here, also, the titles of lectures given during this time: Anatomie der Pflanzen, Fortpflanzungs und Befruchtungserscheinungen, Ueber das Protoplasma, Ueber Gymnospermen und Archegoniaten, Palæophytologie, Ueber Pflanzenkrankheiten, Grundzüge der Botanik, Vegetation des Meeres, Ueber der Thallophyten, Ueber Nutz- und Arzneigewächse. Besides these, lectures were given in the agricultural department on plant nutrition, growth, etc., also of botanical interest. Some of the lectures were free courses, representing the latest work of the professor on some special subject. Some were attended by fifty or seventy-five students, others by four.

In summer there are usually one or two excursions weekly to points of botanical interest, which often means a short railway journey and always a hard tramp. Professors and students are then at their best, unreserved and jolly, striding away across the fields often in disregard of the law requiring pedestrians to keep to the beaten paths, until some irate peasant halts the party, and the young fellows, with winks and nudges among themselves, watch the professor banter with Hans. Then, when the masquerade is revealed, "Donnerwetter" changes to "Entschuldigen Sie," and all is well, although it sometimes happens that nothing but the payment of the regular three marks' fine will secure the peaceful and undisputed progress of the expedition. An unfailing feature is the halt for lunch at some convenient "Gasthaus," where, over black bread and sausage and mugs of foaming beer, many an interesting botanical question as well as jolly joke or story is discussed. If a part of the excursion is by rail, tickets are taken third class, and even these are obtained, in such cases, at reduced rates.

At play or at work I have found the German professors and students wholly interested and in earnest. Perhaps thus their work obtains a character of reliability and thoroughness; perhaps thus they are able to derive such satisfaction from the most minute and tedious investigations and inspire in new students such enthusiasm and devotion. Certainly, working or playing, I was glad to count my connection with the botanical people at Göttingen among the pleasantest of my university experiences.

Amherst, Mass.

Notes on Andropogon.

F. LAMSON SCRIBNER.

Prof. E. Hackel, in his contribution (Gramineæ) to Engler's great work on the families of plants (Die Pflanzenfamilien), has extended the genus Andropogon so as to include a number of grasses which have been for some time regarded as belonging to distinct genera. The genus is divided into 12 subgenera, among which are Sorghum, Chrysopogon and Heteropogon. Based on this classification, Prof. Hackel recognizes 25 species as belonging to the United States. The following is the list in full, kindly furnished me by Prof.

Hackel in advance of his "Monographia Andropogonearum," which is now in press, and will be published next year:

1. A. semiberbis Kunth.
2. A. hirtiflorus Kunth.
    subvar. oligostachyus Hack.
    subvar. feensis Hack.
3. A. cirratus Hack.
4. A. tener Kunth.
5. A. scoparius Michx.
    subsp. genuinus Hack.
        (There are no other varieties distinguished, but some forms are named.
    subsp. maritimus Hack.
        var. *a.* maritimus (S. States).
        var. *b.* divergens (Texas).
6. A. gracilis Spr.
7. A. macrourus Michx.
    a. genuinus.
    b. abbreviatus Hack.
    c. hirsutior Hack. (vaginis tuberculato-villosis, Mobile, leg. C. Mohr).
    d. corymbosus Chapm.
    e. glaucopsis Chapm.
8. A. Virginicus L.
    a. genuinus Hack.
        with subvar. stenophyllus Hack.
    b. glaucus Hack.
    c. dealbatus Hack.
    d. tetrastachyus Hack.
9. A. Leibmanni Hack.
    var. *b.* Mohrii Hack.
10. A. longiberbis Hack.
11. A. Elliottii Chapm.! (non A. vaginatus Ell., sed A. clandestinus Hale.
12. A. brachystachyus Chapm.
13. A. arctatus Chapm.
14. A. argyreus Schult.
15. A. Cabanisii Hack.
16. A. provincialis Lam.
17. A. Hallii Hack. (cum var. flaveolus, incanescens, muticus).
18. A. Wrightii Hack. (Wright, New Mex. coll. no. 2104).
19. A. saccharoides S. W.
    var. Torreyanus Hack
    var. submuticus (Texas, leg. Nealley).
    var. perforatus (A. perforatus Trin. Texas, Berlandier, no. 641, Lindheimer no. 1161).
20. A. Sorghum Brot.
    subsp. halapensis Hack. (Sorghum sp. Pers.).
    subsp. sativus (cultivated sorghum, the varieties of which are very numerous).
21. A. nutans L. (with vars).
22. A. unilateralis Hack. (Sorghum secundum Chapm. This can not be named A. secundus in consequence of A. secundus. Willd.)
23. A. pauciflorus Hack. (Sorghum pauciflorum Chapm., but it is not of the Sorghum section, but belongs to Chrysopogon).
24. A. contortus L. (Heteropogon sp. R. & S.).
25. A. melanocarpus Ell.

The changes in Patterson's Catalogue, following from this arrangement are as follows:

Andropogon dissitiflorus Mx.=A. Virginicus L.: A. Mohrii Hack= A. Leibmanni, var. *b.*: A. saccharoides S. W., var. inermis Vasey= var. submuticus Hack.: the var. maritimus under A. scoparius is raised to a subspecies: Chrysopogon nutans=A. nutans L.: C. secundum=A. unilateralis Hack.: C. Wrightii=A. pauciflorus Hack.: Heteropogon acuminatus=A. melanocarpus Ell.: H. contortus=A. contortus L.: Sorghum halapense=A Sorghum Brot., var. halapensis Hack.

There are some new varieties; other varieties reduced to forms; and others wholly omitted.

In the letter communicating the above list of Andropogons (dated June 10), Professor Hackel says: "As to other Andropogoneæ, there are some changes in nomenclature, viz.: Imperata brevifolia Vasey is I. Hookeri Rupr.: 'Elionurus candidus' from Texas and Arizona is not E. candidus Hackel in Flor. Brazil., but a new species named E. barbiculmis: 'Elionurus Nuttallianus' of Vasey, Grasses of the U. S., is the type of E. tripsacoides HBK.: Rottbœllia corrugata Baldw. is recognized as a species, with the variety areolata: R. tesselata Steud. is a form of R. corrugata: R. rugosa has a var. Chapmani (Curtiss, no. 3622)."

Washington, D. C.

Notes on the inflorescence of Callitriche.[1]

JOSEPH SCHRENK.

While examining the flowers of *Callitriche heterophylla* Pursh, I noticed some peculiarities about the so-called *bracts* of the inflorescence which seem to have escaped notice thus far.

For the sake of completeness I will briefly state that the species examined has dense floating tufts of broadly spatulate opposite leaves, each bearing in its axil one, sometimes two pistils, and one stamen[2] between a pair of the bracts mentioned. The latter are of a semilunar shape, attached by one of the attenuated ends to the stem, the concave sides turned toward the pistil.

Of such bracts, including those met with in other families, Hydrilleæ, Naiadeæ, Potameæ, etc., H. Schenck, in his elaborate paper on the "Comparative anatomy of submersed plants,"[3] says: "These structures are no stipules, as Caspary calls them, but true trichomes. They are found in the axils of the leaves in the form of tender, transparent, roundish or elongated, small scales, consisting of one or two layers of cells. They originate early at the apex of the stem, develop more rapidly, and perish sooner than the neighboring leaves. Probably they all produce a secretion which envelops the growing apex." This paragraph refers to the following passage on the preceding page: "Most likely this secretion protects the meristematic apex and the young leaf buds against parasites, etc., but for the present we can not insist on the correctness of this explanation."

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[1] Read before Section F, A. A. A. S., August 16, 1888.

[2] In the numerous specimens examined I noticed that when there were two pistils in one axil the stamen was invariably wanting.

[3] Bibl. bot., Vol. I, 1887, p. 10.—The "Monograph on the genus *Callitriche*," by Fr. Hegelmaier (1864) I was unable to consult, and had to be satisfied with the statements of Schenck (l. c.) and de Bary (Comp. Anat.) referring to it.

A close inspection of the structures in question will show that they are not simple scales or trichomes, but small bladders or sacs. When held under a lens, in air, they might easily be mistaken for flat scales, but when examined with a low power in the fresh condition, under water, they are invariably found to be filled with air, and thus they can be recognized as bladders without difficulty. That the air is really inside the sacs can also be readily demonstrated by gently warming the water on the slide on which they are placed, when they will be seen to expand considerably. When the sacs are placed in boiling water, the air is at last driven out. This is, in fact, the most convenient way to get rid of the air, for even after long continued treatment in alcohol air bubbles will still remain in the sacs.

Under higher powers the surface view and sections of the bladders show that their wall is a thin membrane formed of a single layer of transparent, elongated, flat cells with very sinuous side walls. Inside of the bladder a slender thread can be distinguished, which projects from the base into the cavity. It consists of two or three rows of long, wavy cells laterally connected by short branches.

At the meristematic apex of the stem, on the youngest node, the sacs are found as small protuberances alongside the rudimentary pistil. They consist of the epidermis, which bulges out in the angle between leaf and pistil, and covers only a few rounded cells that belong to the meristematic interior of the apex. At the next lower node these excresences are much larger. The epidermis cells still have a rounded outline, while the few enclosed cells begin to elongate perceptibly. Examining still older nodes we find that the development of the sacs has been completed. The cells of its wall have increased rapidly in number and size, and have assumed the wavy outline peculiar to so many epidermis cells. The growth of the cells which originally filled the sac has not kept pace with its surface growth, and they have remained as a contorted and isolated thread in the interior of the sac, while the walls have receded and expanded.

Thus a hollow plant organ is formed by schizogenetic growth, which it is impossible to designate a "trichome," for it is evidently not merely an outgrowth of the epidermis. On thin longitudinal sections the continuity of the air-spaces in the larger air-channels of the internode, in the intercellular cavities of the node, and, finally, in the interior of the sacs, can be traced distinctly. I would, therefore, call these sacs, not trichomes, but reduced, or rather transformed phyllomes, transformed in order to fulfil a special function, *i. e.*, to give the apex of the stem necessary buoyancy, so that the leaves may receive light and air, and the pistils and stamens the visits of insects or the currents of the air.

At no stage could any secretion exuding from the sacs be noticed. The protoplasm contained in the cells, although plainly visible at the early stages, is too insignificant to indicate that intense activity which is going on in secretory organs; besides, the comparative isolation of the cells, which are really simply epidermis cells, speaks against such a function. But I would call attention to the peculiar fan-shaped, or rather palm-shaped hairs[4] found at the nodes in considerable numbers, which most likely produce some kind of secretion. Their walls are filled with dense, granular protoplasm, and are quite thick, presenting on the addition of reagents the peculiar appearance of mucilage-producing membranes. Besides, the fact that they are found fully developed at the very apex of the growing stem, when all the other organs, the sacs included, just begin to differentiate, leaves hardly any doubt that they serve for the protection of those points that are most in need of it.

For systematic botany the question is of great interest, whether each, the pistil and the stamen of Callitriche, is to be considered a separate flower or not. In most text-books[5] the flowers are described as monœcious. In my opinion, the histology of the inflorescence ought to decide the question.

On a longitudinal median section of the stem, through a young node, we see a central fibro-vascular bundle which receives additional strands of vessels on both sides from the leaves. In each of the two angles thus formed there arises a vascular bundle which, after proceeding a short distance, separates into two slender branches; one of them, the one nearer to the leaf, leads to the pistil, and the other, the upper one, to the stamen. The other tissues of pistil and stamen are arranged correspondingly, so that, *e. g.*, the epidermis of the filament and of the short pedicel of the pistil are a continuous layer of cells.

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[4] Cf. DeBary, Comp. Anat. Engl. ed., p. 64.

[5] *e. g.*, Gray's Manual, Eichler's Syllabus.

There is no reason why, under these circumstances, we should separate these two organs and call them two different flowers, when, in fact, they could not be any more closely connected than they really are.

Hoboken, N. J.

Undescribed plants from Guatemala. V.

JOHN DONNELL SMITH.

(WITH PLATES XXIII and XXIV.)

VOCHYSIA GUATEMALENSIS. Bot. Gazette, XII, 131. Explanation of Plate XXIII: Fig. 1. Flowering branch—natural size. Fig. 2. Immature capsule. Fig. 3. Flower. Fig. 4. Same with pistil exposed. Fig. 5. Staminode. Fig. 6. Stamen. Fig. 7. Anterior petal. Fig. 8. One of the lateral petals. Fig. 9. Vertical section of ovary. Fig. 10. Ovule. Fig. 11. Diagram of flower. (Figs. 3–11 are variously enlarged.)

Hanburia parviflora.—Leaves roundish, base emarginate, 5–6 inches long, 5-times exceeding petiole, triplinerved, tripartite nearly to base, divisions oblong-lanceolate: shortly peduncled racemes 12–15-flowered, flexuose, nodding, twice exceeding petioles, spreading pedicels equalling flowers: calyx urceolate-campanulate, 6 lines long, nearly half as broad, teeth minute: corolla-segments ovate, half as long as calyx, reflexed: filament-column 4 lines long, antheriferous globose-turbinate head 2 lines broad, cells in 10–12 pairs: pistillate flowers not seen.—The other species of this genus, *H. Mexicana* Seem., has long-petioled uniformly undivided leaves exceeded by peduncles of rigid racemes, sparse twice-larger flowers, a shortly campanulate calyx, anther-cells in more numerous lines.—Pansamalà, alt. 3,800 feet, April, 1888. (Ex Pl. Guat. Tuerckh., qu. edid. J. D. S., 1366.)

Calea trichotoma.— Branches divaricate, fusco-tomentose: leaves petiolate, 12–18 lines long, subcordate, triplinerved, remotely serrulate, scabrid above, cano-tomentose beneath: pedicels of simple or compound terminal corymbs 3, half an inch or less long, monocephalous: heads homogamous, about 20-flowered, subglobose, 5 lines high; exterior bracts of involucre foliaceous, scabrid, ovate, minute; interior ones smooth, oblong, obtuse, exceeded by disk; bracts of conic receptacle conduplicate, laciniate, rostrate: palets of pappus 20–23, linear-tapering, nearly naked, subequalling corolla; achenia pubescent.—Nearest, especially in foliage, to the Columbian *C. glomerata* Klatt., Bot. Jahrb. VIII, 45. Rocky mountain sides near Coban, alt. 4,300 feet, Aug., 1887. (Ex Pl. cit. 1353.)

PITCAIRNIA TUERCKHEIMII. Bot. Gazette, XIII, 190. Explanation of Plate XXIV: Fig. 1. Plant, nat. size. Fig. 2. Vertical section of flowers nat. size.

Baltimore, Md.

BRIEFER ARTICLES.

Œnothera albicaulis.—The order Onagraceæ contains many interesting and beautiful species and this species is not the least deserving of notice. The flowers are large, white at first, later turning to a delicate rose-color, and very conspicuous. One evening during July I was walking with a gentleman from the barn to the house. We passed along the edge of a kitchen garden, and when near the house I called his attention to a large patch of Œnothera albicaulis which had never known the hoe. He admired the flowers, remarking that they were worth cultivating for ornament. We had not gone ten yards beyond them when a most offensive, sickening fœtid odor assailed our nostrils. At first we could not account for it, because we knew of no carrion in the vicinity. At last I concluded it arose from a stink-horn of some kind, and proposed to immediately find the offender. I turned my head for a last look at the beautiful evening primrose, and at that very instant the strange odor filled the air again, coming like a puff of warm breath from the direction of the flowers. Standing still a few moments I felt three more warm puffs, and each time was nearly overpowered by the accompanying smell. Subsequently I had an opportunity of observing the plant a little more closely. I found the puffs were stronger and more frequent on mild, still evenings; that they were then emitted, several in quick succession, at intervals ranging from twenty to thirty minutes. I never watched the plants all night, but have watched from eight in the evening till nearly two in the morning, and found that the puffs were stronger, more frequent and more regular between 9 and 12 P. M. than before or after. The flowers are influenced in opening and closing more by temperature than by the degree of light. When the morning is not too warm, that is to say not over 65° or 70° F., the flowers commonly remain open till 10 or 11 A. M. Likewise in the afternoon, when the heat is not too great, they begin to expand about 4 o'clock; at other times they may not open till 6 o'clock. I have taken "wilted" flowers, plucked during the heat of the day, placed their stems in a glass of water and removed the glass to a cool cellar with a northern aspect and plenty of light. In the course of an hour the flowers would slowly open. They seem to be very irregular in their habit. During the middle of the day the petals are wrinkled and loosely folded; the tube droops; the whole flower is limp and seemingly wilted, presenting a sorry appearance.—F. W. Anderson, *Great Falls, Montana.*

Some Nebraska plants.—In a recent visit to Clear Water, Neb., I was much impressed and somewhat surprised with the abundance and beauty of the wild flowers. Clear Water is a small town in the northern part of Antelope county, near where a creek of the same name flows into the Elkhorn river. Along the Elkhorn, and also along Clear Water creek, there is some timber, which in that region is deemed a luxury. The most abundant timber is the different species of willow, while the largest and most conspicuous tree is Populus monilifera. Fraxinus viridis, Negundo aceroides and Celtis occidentalis are frequently met with. Juglans nigra was not seen in this immediate vicinity, but it grows quite plentifully on Verdigris creek, in this county. Two shrubs which claimed my attention were Amorpha fruticosa and Shepherdia argentea. The latter is rarely met with. But one clump of these bushes was seen in the county. Amorpha fruticosa is plentiful, and when in flower is a very handsome shrub. Symphoricarpos occidentalis is abundant, and its flowers very pretty, although it is considered a great nuisance by cultivators of the soil. Rhus glabra is occasionally seen, while R. Toxicodendron is too abundant.

One of the first flowers to grace the prairies here in early spring is Townsendia sericea. It usually appears in April, before the spring grass or much other vegetation, which makes it seem prettier than it otherwise would be. Petalostemon villosus is so abundant that seen from a distance when in bloom it gives a rose-colored hue to the prairie. P. violaceus and P. candidus are both here, but not so plentiful as P. villosus. Three species of Pentstemon were noticed, of which P. grandiflora was the most conspicuous. Of the four species of Astragalus which were observed, A. caryocarpus seems to be the most common, and, for some reason, a favorite among the people. Cypripedium candidum, which is thought to be rare in the state, is quite commonly met with here. There is an abundance of wild roses of different hues, all of which belong to the same species, Rosa Arkansana. Two plants, Taraxacum officinale and Cnicus arvensis, which have in the last year or two been introduced, are likely to become great pests to the farmers.—Emma R. McGee, *Clearwater, Neb.*

The clover rust.—*Uromyces trifolii* (A. & S.) Wint. has appeared on

Trifolium pratense in this vicinity in great abundance and is doing much damage. It seems to be most abundant in the aftermath, though it is not confined to the clover of meadows. In many instances the rust is so abundant that the clover leaves are half or more dry and dead. I should say the damage would vary from 5 to 20 per cent. of the value of the clover. So far as I know, the parasite has never been reported on T. pratense from this country before, though it is known in Europe. (*Cf.* Winter, *Die Pilze*, i, 159.) Two years ago it was abundant here on T. hybridum, but this year it seems to have changed to the red clover. T. hybridum is also a new host for America. *Uromyces medicagenis-falcatæ* (DC.) Wint. on Medicago lupulina has been abundant here every year since 1883.—LUCIEN M. UNDERWOOD, *Syracuse University, Syracuse, N. Y.*

Diœcism in Andropogon provincialis.—The Iowa experiment station has been collecting seeds of some of the native prairie grasses for the purpose of testing their value under cultivation. The one regarded as of most promise is *Andropogon provincialis* Lam., called Blue Stem or Blue Joint. At first little or no seed was found on this species; then some plants were noticed which were smaller and darker in color than the others, and so different that they seemed to be a distinct variety. The spikes of these plants proved to be well filled with seed. After this it was seen that wherever Blue Joint was found a small proportion of the plants were of this form. The spikes of these fertile plants ripen and break up earlier than those of the sterile plants. Not all of these, however, have the heads well filled with seed. The sterile plants have conspicuous stamens with abundant pollen, and also large fully expanded stigmas. The division into staminate and pistillate plants is perhaps only partial. Circumstances did not permit a more extended examination at the time, but plants of each form have been marked for future study. It would be well also for others conveniently situated to take notice regarding this feature. If it shall prove to be a permanent habit of this grass to have but few of the individuals fertile it will be a serious difficulty in the way of its profitable cultivation.—A. A. CROZIER, *Ames, Iowa.*

EDITORIAL.

THE EDITOR of *Grevillea*, in the September issue of that journal, accuses "some of the junior mycologists of the United States" of "committing a dangerous mistake" and of indulging in "spread-eagleism" regarding the identity of certain type specimens. Dr. Curtis collected the series of fungi known as *Herb. Curtis.* The descriptions of the new species were drawn up by Rev. M. J. Berkeley, of England, and published under the joint authority of Berkeley & Curtis. Now some American has allowed his love of country, so we are to infer, to blind him to the evident fact that where a real difference exists between a specimen in the Curtis herbarium and one in the Berkeley herbarium, it is the latter only which is to be regarded as the type. This is so obviously true that we fear that Mr. Cooke was under some misapprehension when writing his warning. But while the simple statement seems to be beyond controversy, differences may still arise as to the interpretation of the Berkeley & Curtis types. Because a cursory examination appears to make out the type specimen in the Berkeley collection to be different from the corresponding specimen in the Curtis set, it does not necessarily follow that it is really so. It is quite possible that errors might have arisen in the original study, and that the specimen in the Curtis herbarium, although different, might yet be a better representative of the real species than the type specimen itself. There is often internal evidence to show that certain specimens in Herb. Curtis, although in some characters different, are still undoubtedly the same as those in Herb. Berkeley. For instance, if a leaf with a Puccinia has been cut in two and half sent to Rev. Berkeley and half placed in the Herb. Curtis, the description in many respects corresponding to the Curtis plant, but not in others, we are not to infer that there were two distinct things, but rather that the Curtis plant is genuine, and a study of it can show facts not previously brought out. There is so much need of cautious work in determining the species and settling the nomenclature of our fungi that it can not be amiss to point out this possible source of misunderstanding.

CURRENT LITERATURE.

Minor Notices.

THE FLORA of the Santa Barbara Islands is the subject of a paper[1] by Mr. T. S. Brandegee. The author investigated the two largest islands, Santa Cruz and Santa Rosa, and in the paper before us gives a list of the plants found. A comparison is made between this flora and that of the neighboring Santa Inez mountains on the mainland. Of the almost 400 species, nearly 380 may be considered as belonging to the San Diego flora, leaving some ten or twelve endemic species. There are, besides these, some nine or ten species not found on the mainland, but are common to other coast islands.

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[1] BRANDEGEE, T. S.—Flora of the Santa Barbara Islands. Reprint from Proc. Cal. Acad. Sci., 2d Ser., Vol. I, Part 2. pp. 201-226. Issued October, 1888.

NOTES AND NEWS.

NEW SPECIES of Saussurea by Franchet, and of Clavaria by Boudier and Patouillard, are described in *Journal de Botanique* (Oct. 4).

PROF. JAS. E. HUMPHREY has been elected to the new professorship of Vegetable Physiology at the Massachusetts State Agricultural Experiment Station at Amherst. He enters upon his work November 1.

IT SEEMS that German colonists in Australia introduced their native fruit trees, such as pears, apples, etc., and although they flowered abundantly, no fruit was produced. Lately another colonist brought bees from Europe and the trees are fruiting well.

A NEW GENUS of Berberidaceæ, from Japan, is described in *Jour. Bot.* (Oct.) by Tokutaro Ito. It perhaps comes between Podophyllum and Diphylleia, and is dedicated to the "Linné du Japon," Ono Ranzan, being called Ranzania. We are also assured of the certain occurrence of Podophyllum peltatum in Japan.

THE MARINE LABORATORY at Wood's Holl, Mass., proposes to extend its facilities the coming year to botanical students and investigators. This is, doubtless, one of the most favored spots for the study of marine vegetation on our Atlantic coast, and opening a well equipped laboratory to botanists is likely to be appreciated.

DR. JAMES CLARK, of England, but now at the Botanisches Institut, Tübingen, Germany, has under way a monograph of the Gentianaceæ, begun at the request of Professor Huxley. He will be greatly obliged to American botanists who will send him material. He especially desires ripe seeds of our native species, even of the common kinds, such as G. Andrewsii. The author aims at much more than a merely systematic study of the group.

A COMPLETE ENUMERATION of all known Uredineæ, arranged according to the orders to which their host plan's belong, has been published by Dr. P. Dietel, through a Leipzig firm. It covers forty-eight octavo pages with eight additional pages of index. There is evidence of careful compilation, and the work will be heartily appreciated by all students of the ru-ts. The author would do good service by also issuing a bibliography of this group of plants.

THE FOLLOWING NOTE from an English scientific (?) periodical, just received, may be of interest to American readers: "Among the wonders of the 'Wild West' that have recently been discovered is a vegetable compass. The American Association for the Advancement of Science publishes in its transactions a report penned by General Abford, of the United States Army, and treating of an extraordinary plant growing wild in the states of Oregon and Texas, the leaves of which point due north and south, and are consequently utilized by belated prairie-hunters as convenient substitutes for the magnetic needle. Prof. Gray Meehan, who has examined specimens of this gifted shrub at the request of the Association, defines it as dwarf variety of the osier, named Sylphium Laciniatum." We consider this item a gem worth preserving.

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Strassburg and its botanical laboratory.

WILLIAM R. DUDLEY.

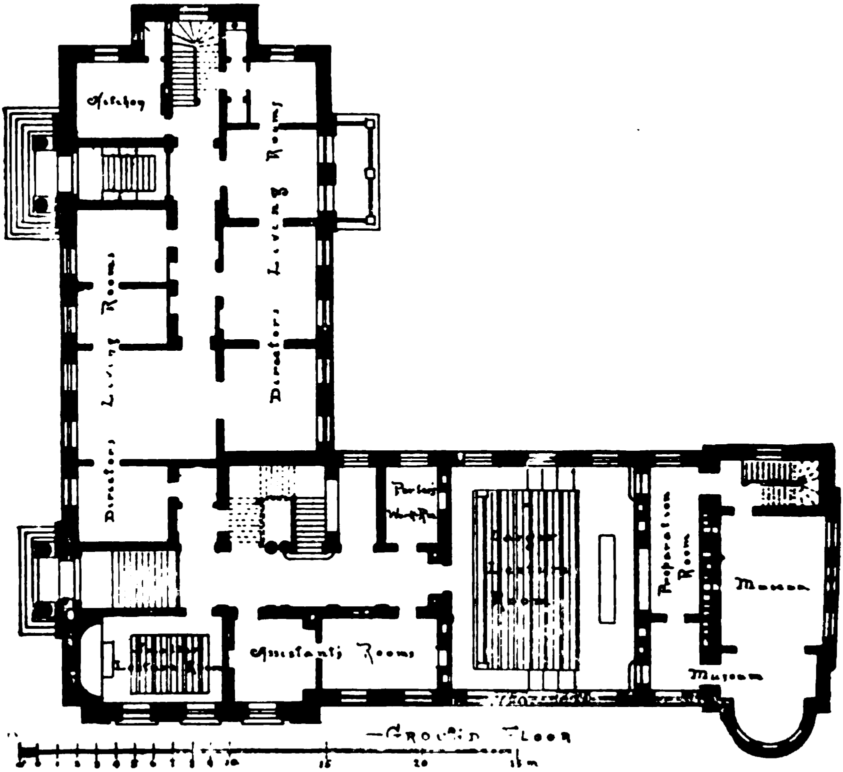
The city of Strassburg contains two widely different quarters; first, the old city, full of narrow streets and quaint houses, whose crown and glory is the great cathedral near its center; second, the new quarter, added to the city by the extension of its walls after the German occupation in 1871, and containing wholly modern buildings. Among the latter are the new imperial palace and the great quadrangle of the new "Kaiser Wilhelm" University. A considerable area of this new quarter is still unoccupied.

MAIN ENTRANCE TO LABORATORY, NORTH SIDE.

Extending across the end of the quadrangle and facing the distant palace is the great University building, 400 feet long, designed for lectures in philosophy, literature, mathematics, law, theology, etc. In the rear on the left side is the Chemical Institute; on the right the Physical and Botanical Institutes, and farther back the Observatory. Between the Botanical Institute and the Observatory lies the Botanical Garden with its greenhouses, Victoria House and artificial pond. On a neighboring quadrangle other buildings for science are being erected; in another part of the city are the numerous buildings of the Medical School, while the Library of over 600,000 volumes occupies the old Bishop's Palace near the cathedral.

It is rare to find the buildings of German universities grouped together in this altogether American fashion, or making such an imposing display as do these fine examples on the quadrangle of the "German Renaissance" style of architecture. The structures are of a light-gray stone, often with stone staircases and corridors, and are fire-proof throughout.

A ground plan of two floors of the Botanical Institute, the ground floor and the story above the latter, called on the continent the "first floor," accompanies this sketch. These



are from tracings of drawings kindly furnished me by Prof. Zacharias and Dr. Jost, of the Institute, and deserve a careful inspection by all interested in laboratory arrangements.

Among the peculiar features, it will be noticed that a considerable portion of the building is reserved as a residence for the Director and his family, and that two rooms are allotted to the Director's assistant, commonly a young man who has recently made his doctorate. The writer also has plans of the basement and attic stories; and these show rooms for the porter and his family, and for that excellent servant of German laboratories, the "Diener," or laboratory porter or waiter. To group all these people in the "Institute" building is a common practice in German universities.

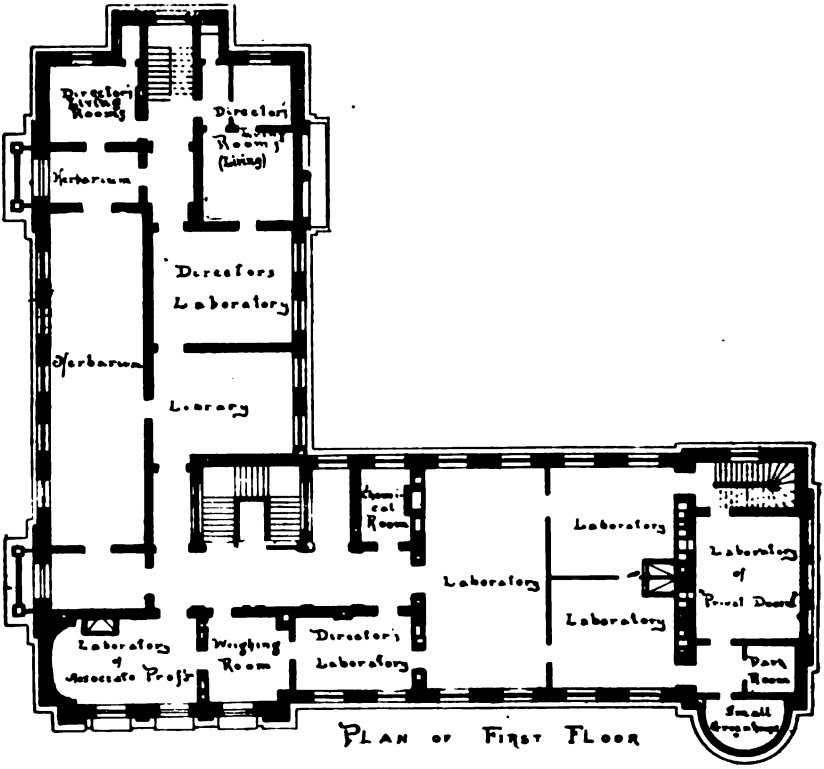
The "Preparation Room," as it seemed best to call it on the plan, is one used in preparing for lectures, and is convenient for carrying on certain work in connection with the illustrative museum (or "Lehrsammlung") in the rear.

The little greenhouse on the first floor is of the greatest convenience. Sections of its glass roof can be raised, and, if necessary, a platform, bearing jars or pots containing cultures, can be rolled out on a track into the open air. The laboratory rooms are especially interesting, as representing the most recent expression of the mature judgment of Germany's ablest laboratory director, de Bary.

No doubt the architect who designed the building is accountable for cutting it up into symmetrical squares; any German architect who failed in this would be sure to die unhappy. Nevertheless, for the sequence of the rooms and for the details, de Bary was responsible, and, taking everything into consideration, it is considered in Germany their best single laboratory for botany.

Its chief characteristics are the abundance of all necessary appliances and apparatus, cleanliness and orderly disposition of all its supplies, good light from huge windows and white wall-surfaces. Wall-cases are numerous and the contained glass-ware, reagents, etc., nicely arranged. Drawers are abundant, this one containing only reagent tubes, that glass plates, another pipettes, burettes, etc., etc. Running water is convenient, of course, and distilled water and three grades of alcohol where they can be readily obtained by students if necessary. There are several sterilizing boxes in the large laboratories; also constant-temperature boxes provided with thermostats. The chemical room is provided with a hood for fumes and for the steam generated by the steam sterilizing cylinders. Gas is provided at each table, and a separate room is set apart for delicate instruments, such as balances. Indeed the association and dissociation of rooms and apparatus, the conveniences, the absence of unnecessary things and showy effects, indicate the intelligence and discernment of a worker and a master.

The tables are broad, very heavy and designed so as to prevent warping or seaming. They are convenient for two beginners or a single special student. Each person is provided, at the outset, with about a dozen common reagents and fluids. The microscopes for laboratory use are chiefly Hartnack. Most of the private microscopes in the laboratory at the time I was there were from Seibert, an excellent Wetzlar manufacturer, not well known in America; and one or two from Zeiss. The stock of reagents in the cases is large, and, if necessary, new ones will be cheerfully ordered. The University requires of special students working every day in the laboratory, a payment of fifteen dollars, which covers all necessary expenses.



Strassburg University had about 1000 students during the winter semester of 1887–'88, and 104 professors, privat-docents and assistants. It is, therefore, neither one of the largest, nor one of the smallest, of Germany's twenty-one universities.

The Botanical Laboratory had six advanced and five beginning students, and I do not think the number was affected by de Bary's illness. To instruct or counsel these were four instructors: The professor; the associate professor, Dr. Zacharias; the privat-docent, Dr. Wortman; and the assistant, Dr. Jost—all contributors, in a greater or less degree, to science, and of course well-trained men. At least three of the advanced students were working quite independently during de Bary's illness, although it was the latter's custom to inquire nearly every day after the work of the advanced students, when he was in health. But the German government, which employs and pays these instructors, is not afflicted with that particular kind of malaria which enters into the management of almost every American institution, and gives it alternate chills and fever over fall and rise in numbers. Numbers are a matter of indifference to it. A very distinguished German professor once said to me: "The truth is, we teach whatever we please, we do as much or as little as we please, and the government does not interfere with us." Yet these men teach enthusiastically, and accomplish in scientific research ten times as much as the American professor, who is "personally conducted" by a whole board of trustees. The German government *does* "person-

BOTANICAL LABORATORY, FROM THE GARDEN. SOUTH SIDE.

ally conduct," however, in certain very important matters. In the first place it provides a suitable corps of assistants, and makes it sure, therefore, that the professor has *not* too great a burden of teaching on his hands. It provides ample appropriations; it appoints its professors for merit, and it sends up its students from the secondary schools with an excellent and uniform training.

The advanced students were mostly engaged in bacteriological investigations, although one was working out certain biological questions of fern development. Professor Zacharias was engaged in histological work, Dr. Wortman in physiology, and Dr. Jost completed a paper during the winter on the morphology of certain mistletoes.

In the "Lehrsammlung" are numerous beautiful preparations, some made by de Bary, and at once recognizable as the originals of well-known figures in his published works; and some by former pupils, some of whom are now famous men. These preparations are frequently used in illustrating the lectures, all of which were held late in the afternoon or in the evening.

The herbarium collection is not relatively large, and is situated, it will be observed, rather remote from the other rooms. Had de Bary been a systematist, he would no doubt have placed his herbarium centrally. Instead, the large laboratories, the rooms which have seen so many distinguished investigators, and witnessed so many scientific discoveries under the guidance of the great director, are the rooms around which the others are clustered.

The library, stocked with a fairly good number of the important serials, together with a few standard works in the principal departments of botany, is placed nearer the laboratory; and in this, every Monday evening, meets the "Botanical Colloquium," made up of the advanced students of the laboratory and the instructors. Certain members give carefully prepared abstracts and reviews of the current botanical literature, which are followed by spirited discussions. After an hour or more of arduous and profitable labor of this kind, by means of which each member is enabled to keep quite abreast of advanced lines of work, they adjourn to a more convivial place and spend the remainder of the evening in the relaxation natural to the German. By eleven o'clock all their vast learning, and especially the hard facts of the recent Colloquium, are in a state of saturated solution, and by next morning are quite ready for use.

The foreigner who has attended a German university always recalls the university town with feelings of decided pleasure. The quaintness and character of most of these towns, especially in South Germany, furnish a pictorial setting to his experience and work that is wholly new to him. Strassburg, a city of about 115,000 people, has an individuality greater than most cities. From its strategical importance it has been much fought over, and a variety of ownership has given it a mixed population and a mixed language. One sees on its narrow streets the dark complexion and regular, handsome features of the Frank combined with the strong frame of the German, and hears both languages spoken by the same person with equal fluency. And the peasant on the country road or in the market, and the blue capped and cloaked school-boy on the street, shout their Alsatian *patois*—neither French nor German—in the sing-song, cheery tones peculiar to the people of the Upper Rhine valley. It is the strongest fortress in Germany, and the presence of a garrison of 12,000 gives it a lively military aspect. Gœthe took his degree in the university, studied here with Herder, Lenz, Lavater and Stilling, and the bryologist Schimper was long a professor here. Indeed, when one reverts to the numerous associations connected with every ancient street and square, and with many of the houses whose steep, tiled and chimneyed roofs and rich wood-carving date back two to four centuries, and especially when he recalls that most attractive of the old Gothic cathedrals and the scenes witnessed in and around it, he can readily appreciate the loyalty the exiled Strassburger is always said to feel.

LARGE GREENHOUSE IN BOTANIC GARDEN.

Strassburg.

Development of cork-wings on certain trees. III.

EMILY L. GREGORY.

(WITH PLATE XXV.)

Of the genus Euonymus, the species now known as alatus, formerly described as *Celastrus alatus* Thunb., presents the most marked and striking example of what is known as cork-wings. The first important consideration on taking up the study of the wing in this genus is, that we have no longer to do with large trees, but with small ones and shrubs. One of our own native varieties, E. Americanus var. obovatus, Gray describes as trailing with rooting branches. Another species has small rootlets scattered over the branches. Closely connected with this fact is another of equal importance, that is, the lasting nature of the epidermis, or the length of time that some part of the surface of the stem performs the function of assimilation. Of the thirteen kinds of Euonymus examined, only five may be said to be winged in the sense in which we have used this term. Nearly all the others, however, present some features which are of use in determining the probable reason for this peculiar formation, exhibited in its strongest form in Euonymus alatus. A complete study of the periderm development of this genus would lead to a more extended treatment than was intended when limiting the study to the development of cork-wings. Certain parts of this subject must therefore be reserved for future consideration, and only those kinds described here which are really winged. These are E. alatus, E. Europæus and three varieties of the latter species, variegata, ovata and purpurea. A comparative study of these five kinds shows little difference existing in the anatomical structure of the wing of Euonymus Europæus and its three varieties. Any one of these may be described as illustrating a weak and less developed form of wing which finds its complete development in E. alatus. The structure of the primary rind of these four kinds is very nearly the same. The mechanical support, which in most dicotyledons and gymnosperms is furnished this rind by means of the bast fibers of the primary vascular bundles, is here wanting. In place of these are two cylinders of collenchymatic cells. These cylinders are connected at each corner by collenchymatic tissue extending from one to the other. This will be readily understood from the diagram, fig. 20. In this, *a* represents the epidermal layer; *b*, the outer cylinder of collenchymatic cells; *c*, the inner, and *d*, the thin-walled chlorophyll-holding cells, which serve the purpose of assimilation, and also to separate the collenchymatic tissue of the rind into the two cylinders. At each corner, *x x*, the collenchymatic tissue extends through to the young phloem tissue. In the species and in the varieties purpurea and variegata the corners are further strengthened by a cluster of extremely thick-walled bast fibers, and it is here at the corners that the wing formation begins. The time varies according to several conditions. One example of E. Europæus just brought in from the tree, September 28th, has one stem on which wings are forming on the second internode, while this is only one-half centimeter in length. On the same plant, another stem has fully 20 centimeters of its length without any appearance of wings. Several internodes of this are fully developed in length, and the lines of bast cells are visible along the four corners.

The wing development on a branch of the variety purpurea was studied from its beginning. A cross section at the distance of ½ centimeter from the growing tip of stem shows the tissues of the rind in a formative stage. The outer wall of the epidermal cells is covered by a thin cuticle, the cells themselves are large, nearly isodiametric, and with thin walls; below the epidermis are two layers of thin-walled cells without chlorophyll, then 4 or 5 layers of parenchymatic chlorophyll-holding cells, and below these again several layers of colorless cells. At the corners of the stem (see fig. 21) the cells connecting the outer and inner cylinders of colorless cells are thick-walled and more or less collenchymatic in structure. A section cut at 3 centimeters from the tip of the stem shows that several important changes have occurred. The two cylinders of colorless cells now begin to take on a collenchymatic appearance, the walls having thickened considerably. The cells of the epidermis are in a state of rapid growth and division, new cells being added to the outer cylinder, whose walls rapidly thicken, as may be seen by sections at the distance of 5 and 7 centimeters from the tip. The cells in the center of the group in the corners (see *c*, figs. 21 and 22) are seen to have increased in diameter, while at the same time their walls are much thinner. These are the cells that afterward become the thick-walled bast fibers. (See *c*, of fig. 23.) There is just here a point of interest in regard to the origin of these bast fibers. Connected with it are also some other facts noted while making this study;

their consideration at the present time would lead us away from the subject in hand and it is therefore deferred. After the bast cells are well developed there begins a change in the character of the remaining collenchymatic cells lying immediately below them ; these begin to stretch tangentially, then to grow and divide by radial walls, so that the circumference of the stem increases more rapidly at the four corners than elsewhere, and at this point, and apparently to meet this emergency, the phellogen layer of the cork-wing arises. A layer of collenchymatic cells extending entirely around the bast cells and joining those under the epidermis becomes the phellogen layer of the cork-cells. In using the word collenchymatic here, it must be understood as referring merely to the shape and thickness of the wall, and not to its nature as permanent tissue. The entire cells of the rind are up to this time in a growing, changing condition.

The origin of the cork-cells may be plainly seen on a section cut at a distance of 25 centimeters from the tip. Here at the points marked *e e*, on fig. 23, may be seen very distinctly the last wall formed in the phellogen cells. It is extremely thin, while the opposite wall of the same cell is very thick. In order to follow the course of growth, the sections were treated as recommended by Sanio, first placed in ammonia, then carefully washed and mounted in glycerine. The rapid growth of the phellogen pushes out the corner cells carrying the bast cells, a break of the epidermis occurs on either side, see *b b*, of fig. 23 ; this goes on till a wing of some size projects from each corner. The usual narrow plate cells mark the end of the season's growth. It is seldom, however, that the second season adds very much to the size of the wing. In the variety ovata, which lacks the bast fibers, the second season's growth of cork-cells appears to spread out from the outer phellogen cells of the first, so the circumference is increased with but very little outlay of material. (See fig. 24.)

Taking up now E. alatus, there are four sharp thin wings extending along the internodes, not at the corners, but as nearly as may be exactly between them. The bright green of the assimilating cells shows in strips between the wings, forming a peculiar contrast in color with the brown of the wings. The structure of the rind differs from that of the varieties already described. The stem is sharply four-angled, but the chlorophyll-holding cells extend entirely around it. They consist of several layers very similar in character to the palisade cells of the leaf. There are no bast cells in the corners. The beginning of the wing takes place ordinarily after the internode has reached its length. The first indication of it externally is a little line of brown flecks at equal distances from the ridges at the corners. These may easily be mistaken for lenticels, but on examination they are found to be the first stages of the wing which originates directly from the stomata. These are distributed thickly and evenly over the surface, are sunken quite deep, as is usual on stems or leaves with a thick cuticle.

This line of brown spots extends along the entire internode, and a cross section through the middle of one of them gives the appearance as in fig. 25. One or two thin sections distant from this strikes across the end of the brown fleck and shows its stomatic origin (see fig. 26). In fig. 25, the cells marked *d* are the phellogen cells, and by contrasting different sections it is seen that these originate in the chlorophyll-holding cells under the air space, and at least three or four layers below those lining it. In this way the cells immediately about the air space are pushed out by the growing cork cells, are more or less broken, and form a debris around the openings of the stomata (see *a* in figs. 25 and 26). In fig. 26 this debris comes from the chlorophyll-holding cells of the central portion which have been shoved over to the end. This exudation is the peculiar mark of this species, for it is sufficient to form a ridge on either side through which the wing pushes its way, and when grown appears to rest in it as in a sort of socket. That this socket forms no part of the wing, is seen from the fact that if the latter be forcibly broken from the stem, the socket always remains, and can only be removed by cutting. (See fig. 28, *d*.) Continuing now the description from the stage seen in fig. 25, new cells are rapidly thrown off by the phellogen layer toward the circumference, and these appear between the ridges in a wedge shape at first, but the phellogen layer rapidly increases the number of its cells by dividing radially, so that the wedge grows rapidly broader at the base. The plate cells mark the end of the year's growth; the second season it is again resumed and continued during the entire summer, quite as much material being expended in this way as in the preceding summer, and from the same layer of cells. There is generally a difference in the color of the two parts of the wing, the second year's growth being lighter. The assimilation cells between the wings remain active until the third season, at which time there often begins the formation of four new ones, which fill up the spaces between the old ones, and thus the whole surface of the stem becomes covered with a periderm, and the phellogen layer becomes continuous. In other cases the intervening spaces are not covered by means of a regular wing, but the cork formation seems to occur about the same time under all the stomata, so that after a time the whole surface is covered by an irregular periderm which grows up nearly even with the sharply projecting wedges of the wings.

Euonymus Americanus has a rind very similar in structure to that of alatus; it has, however, bast fibers in the corners, but they lie below the chlorophyll-holding cells. No wings have been discovered on this species, but it is rather a suggestive fact that on some young branches a line of cork growth often occurs running along the internode, neither in the middle between, nor exactly at, the corners of the stem, but close by these projecting corners. This growth never develops into more than a little brown ridge along under the green one of the corner. It is well known that Euonymus verrucosus has warty projections of cork, which are said to arise from lenticels, though at the time of their origin there is no appearance of periderm, unless the outer cylinder, which we have described as collenchymatic cells, be considered periderm.

Now, if the origin of the wing formation in the preceding five kinds of Euonymus has been correctly traced, it would seem that the usual statement made in reference to the periderm formation of Euonymus is not literally correct when applied to these five kinds. The periderm does not originate from the epidermal cells, if by periderm is meant the corky growth covering older stems, but from certain layers of cells at a greater or less distance below the epidermis. The cells which are cut off from the epidermal layer form an additional support to the outer collenchymatic cylinder, which at first is only two layers in thickness. By means of these additional cells from the epidermis the number is increased often to six or seven layers.

Biological Department, University of Pennsylvania.

EXPLANATION OF PLATES XXII AND XXV.—The first six figures represent diagrammatically the phases of growth of the wings of Quercus macrocarpa. The first four represent one year's growth, the fifth and sixth slightly different phases of a stem of three year's growth; *a a*, the break of the periderm tissue along the line of the five angles; *o o*, the sections of original periderm tissue separated by these fissures; *x x*, the new tissue formed from the phellogen cells after the fissures occur; *y y*, the girdle of narrow plate cells whose walls are of the same chemical nature as those of sections *o o*. The lines between the points *b b*, in figs. 2 and 3, show the band of cork-cells; after the first year's growth the whole circumference is covered by these bands.

FIG. 7. Shows appearance of cross-section of a one-year-old stem in the region designated by *b b*, in fig. 2. The letters correspond to those of fig. 2, except there is in this figure *z*, the parenchymatic cells of the primary cortex or rind, and *m* shows a cell which has recently divided, making three cells.

FIG. 8. Cross-section of one-half of a wing in the stage represented in fig. 4. Lettered to correspond.

FIG. 9. Cross-section of top of wing as represented in fig. 6, stem three years old; sketched after treatment with reagents, therefore walls somewhat distorted.

FIG. 10. Cross section of a stem four years old, natural size. Lettered as the previous figures.

FIGS. 11 to 13 inclusive. Acer campestre. Fig. 11 shows outline of cross-section of first year's growth of stem; *x*, a wing already straightened out along the margin, the hairs at *h* showing that the epidermis is still preserved here. Letters correspond as far as possible to those of Quercus figures.

FIG. 12. Anatomical sketch of cross-section of wing as represented in fig. 11 by the wings x^0 x^0.

FIG. 13. Cross section of a two-year's old stem, natural size.

FIG. 14. Acer monspessulanum; diagrammatic sketch of a cross-section of a two-year-old stem. Letters correspond nearly: *f*, fissure; *x*, first year's wing; *x'*, second year's wing.

FIGS. 15 to 19 inclusive. Liquidambar styraciflua. Fig. 15. Anatomical sketch, in part diagrammatic, of beginning of wing: *a*, the fissure at the opening of lenticel; *b*, fissure made by the cells growing below.

FIG. 16. Cross-section of second year's growth, exact outline; cut June 24th. *a* and *b*, fissures as in fig. 15, *b*; *x*, first year's wing; *x'*, second year's wing; *y*. narrow plate cells of first year; *y'*, those of second year.

FIG. 17. Cross section of two years' old stem.

FIG. 18. Cross-section of four-years' stem.

FIG. 19. Cross-section of six-years' stem.

FIG. 20. Diagram of rind of E. Europæus and varieties. *a*, epidermis; *b*. outside collenchymatic cylinder; *c*, inside cylinder; *d*, chlorophyll holding cells; *e*, bast fibers in corners; *x*, the collenchymatic cells extending to phloem cells.

FIG. 21. Corner of E. Europæus var. purpurea; cross-section cut from stem ½ cm long. *a*, epidermis; *b*, colorless cells below; *c*, collenchymatic cells of corner; *d*, chlorophyll-holding cells.

FIG. 22. Same as 21, but cut at a distance of 3 cm. from tip of stem. Letters as in 21, except that the cells *c* can no longer be called collenchymatic.

FIG. 23. Same as 21, but cut at a distance of 25 cm. from tip of stem. *a*, section of cells burst away from the remaining part; *b b*, the breaks on each side; *c*, bast cells now fully developed; *e e*, phellogen cells, one side of which still show their collenchymatic origin; *f*, elongated collenchymatic cells.

FIG. 24. Diagram of stem of E. ovata wing of first year's growth; *b*, cork growth of second year.

FIG. 25. E. alatus, beginning of wing. *a*, debris formed by the remains of chlorophyll-holding cells of stoma which lined the air space; *b*, heavy cuticle of epidermis in two sections as seen by *b′* and *b″*; *c*, epidermis cell; *d*, cells of phellogen layer; *e*, chlorophyll-holding cells; *f*, collenchymatic cell; *o*, opening of stoma.

FIG. 26. Shows the origin of growth in fig. 25 more plainly: *a*, the debris thrown to the end; *b*, cuticle; *c*, epidermis; *d*, air space of stoma; *e*, chlorophyll-holding cells.

FIG. 27. Diagram of young stem of E. alatus, with only two wings started: *a*, epidermis and outer cylinder; *b*, palisade cells; *c*, inner cylinder; *e*, young cells of phloem and cambium layer; *f*, wood cells; *g*, pith; *x*, wing broken off.

FIG. 28. Sketch of cross-section at early stage, showing how much is gained in circumference by the wing formation. Only two started and not far developed: *a*, epidermis; *b*, debris around the opening of the stoma; *c*, space with no epidermis where wing belongs; *d*, wood; *e*, pith.

FIG. 29. Same as 25, but represents the wing well started: *x*, wing; *y*, phellogen cells; *a*, epidermis and outer cylinder; *b*, palisade cells; *c*, inner cylinder; *d*, cuticle and debris.

FIG. 30. Sketch in outline of a two-year-old wing: *a*, the first; *b*, the second year's growth.

FIG. 31. Cross-section of two-year-old stem: *x*, first year's growth of wing; *y*, second year's; *a*, little wing of second year.

A tramp in the North Carolina mountains. II.

L. N. JOHNSON.

One of the first plants to catch the eye of a stranger in the mountains is the Rhododendron. Before we reached Asheville we began to notice its dark glossy leaves and beautiful pink clusters, brightening the woods along the track, and as we got further west it became abundant. All through the mountains we found the common R. maximum, and we never tired of looking at it. In the lower vallies it was past its prime, but on the highlands and along the ridges it was in full bloom, and the great thickets of dark green, thickly starred with the rose-colored flowers, were worth going far to see.

In Cashier's valley they find the purple-flowered R. Catawbiense, but not a single flower could we find still hanging to its branch.

Another, and the most interesting and remarkable member of the genus, is the R. Vaseyi. This, too, grows in Cashier's valley, over toward Chimney Top. We saw it growing with most of its interesting neighbors in the extensive grounds of Mr. H. P. Kelsey, at Highlands. We are indebted to him for the facts concerning its history.

It was discovered by Vasey, some ten years ago, near Webster, in Jackson county, and not long after in Cashier's valley. It belongs to a section of the genus most of whose representatives are Asiatic, and hence its discovery here was especially noteworthy. It has a bright pinkish corolla, and some of the lobes are spotted at the base, as in R. maximum. It differs markedly from our other rhododendrons in having deciduous leaves.

Jackson county was believed to be the only locality for the species till Mr. S. T. Kelsey discovered it, growing in abundance on Grandfather Mt., Mitchell county, N. C. In each locality it forms great beds, and when in full bloom is said to be magnificent. In Jackson county it grows in rather low grounds, and intermingles with R. maximum, Azalea calendulacea, and A. aborescens, while on Grandfather Mt. it is massed with R. Catawbiense and Kalmia latifolia mostly. It grows almost on top of the mountain, at an elevation of nearly 6,000 feet.

Growing with the Rhododendrons, and, of course, related to them, were the Azaleas, as we have mentioned. The large white blossoms of A. arborescens shed a delicious fragrance along the river banks, but not till we reached the highest mountains did we find A. calendulacea still in bloom. On Wayah Bald, in the Nanteholas, we at last came upon a thicket fairly ablaze with its brilliant flame-colored flowers. It is certainly the most showy species of the genus. The blossoms change their color with age, so one may find on the same hill-side flowers of every shade from scarlet to yellow. Both these species reach a height of a dozen feet or more.

One can not fail to be impressed with the great size reached by many of the Ericaceæ in these mountains. Besides the Rhododendrons, Kalmias and Azaleas, which often reach the size of small trees, there are, among others, a tree-like Clethra (C. acuminata) and the Sorrel-tree (Oxydendrum arboreum). We several times, from a distance, mistook the long, fragrant white racemes of the former for those of the latter, but it was a careless blunder. The Clethra bears its racemes singly on the tips of the branches, while the long, one-sided sprays of the Sorrel-tree are clustered. The flowers of the latter, examined singly, are not particularly beautiful, being only white bells about the size and shape of the blossoms of Vaccinium, but when massed they present a striking appearance. We saw trees of this species which were probably thirty or forty feet high. It takes both its scientific and its common name from the sour taste of the leaves.

We found the Vacciniums almost everywhere, some of them reaching almost to the dignity of small trees, and several possessing an interest to a hungry man aside from their botanical peculiarities. They were in fruit at the time of our visit, though not generally ripe.

One of the most common plants along the water-courses was a puzzle to us for a time, especially as it was in full fruit. Its drooping branches were thickly set with alternate spinulose serrate evergreen leaves, arranged in two ranks, and beneath were long, densely-packed racemes of green fruits, resembling those of Andromeda. It was at length identified as Leucothoe Catesbæi, which blossoms in May and June, fringing the streams with white.

On the very top of Whiteside, growing on the rocks, in the moss, we found a beautiful little heath—Leiophyllum buxifolium. It reaches a height of only five or six inches, and its glossy evergreen leaves are closely matted together. We were, unfortunately, too late to find it in bloom, but, judging from the fruits, it must a month earlier be literally covered with the white flowers.

It seemed like a glimpse of the New England woods to find, as we climbed the mountains, the ground along the road-side covered with the trailing arbutus. We found it on almost all the mountain-sides, and in a few places saw another old friend—the wintergreen.

There were many other small Ericaceæ in the woods—among them the Chimaphila maculata and the two Monotropas, but doubtless the most interesting member of the family in all this region is the Shortia galacifolia. This did not come within the range of our tramp, but we were fortunate enough to see it growing at Mr. Kelsey's, and to obtain specimens. The history of the plant is perhaps not familiar to many of our readers.

It was discovered years ago and described (I think from a specimen in fruit), but the exact locality was forgotten, and all efforts to rediscover it failed till within a few years. Now it is known that in one locality at least it exists in abundance, and it is somewhat of a puzzle how it remained unknown so long.

We ascertained what was possible in regard to its habitat from Mr. Kelsey, who visited the region last spring and collected many specimens, both plants and flowers. We can not do better than let him tell the story in his own words. He says: "Its native habitat is on or near the banks of the Jocassee (lower Whitewater) river, in Jocassee valley, Oconee county, S. C., about thirty-three miles from Highlands. When I was there—the middle of March—it was in full bloom and covered the banks of the river by acres, and extended up and down the river more or less for three miles. In places it grew in solid beds like the Galax aphylla. This one locality, as far as is known, is the only place where Shortia grows in the world, and until quite lately its real presence here was not positively known and determined."

It was growing in abundance on his place, in the shade along the banks of a little brook, where it had been transplanted. With it grew the Galax aphylla, with which we had already become familiar. It was easy to see how Shortia gets its name galacifolia. The leaf very closely resembles that of Galax in general appearance, though the latter is heart-shaped at the base and crenately-toothed, while the former is nearly orbicular and serrate, with rounded mucronate-tipped teeth. In each all the leaves are gathered in a radical cluster. While to one familiar with both the differences are plain, we could see that it would be very easy, on a hasty examination, to confuse Shortia with Galax, when not in flower. May not this partly explain why it has not sooner been recognized? It seems likely that it must exist in other parts of that region, but the chances are certainly in favor of its being overlooked, from this resemblance to Galax, which is abundant almost everywhere in the mountains. This is especially true on account of its very early time of flowering —before most of the spring flowers are out.

As for the flowers themselves, we only saw a single dried specimen, so our description is not worth much. If I mistake not, there rises a slender scape-like stalk from the cluster of radical leaves, and this bears a single blossom about three-fourths of an inch in diameter. The dried flower resembled slightly that of Chimaphila, and like that was white.

In closing this brief account of some Ericaceæ of the mountains, we would call attention to the great number which bear evergreen leaves. Not only are there many small ones like the wintergreen and the Arbutus, but the great masses of Rhododendrons, Kalmias and others, must keep the woods green all the winter through.

Evanston, Ill.

BRIEFER ARTICLES.

Some Maine plants.—A residence of two months during the past summer in Dennysville, Me., very near the "jumping-off place," known as Sail Rock, the most eastern extremity of the United States, and sundry excursions botanical and piscatorial along the coast for fifty miles or more, brought to light a few botanical facts of interest.

Euphrasia officinalis, previously collected on the Plains of Abraham, near Quebec, of very dense, compact habit, here occurs in great abundance, so as to be quite conspicuous along the roadsides, and even over the pastures, but loose and branching. It is not found farther inland than twenty miles, but extends along the coast as far as Marchion.

Rubus Chamæmorus, the cloud-berry, known among the natives as "baked-apple," occurs in sphagnous swamps in such quantities as to be brought to the stores for sale, though not very attractive to most of us. Mr. Kennan says that the Siberian variety is much more palatable. I had hitherto seen this only on some of the summits of the White Mountains.

Empetrum nigrum occurs also abundantly in company with the last.

Rhinanthus Crista-Galli is a troublesome weed in the fields and pastures within a few miles of the coast, its inflated seed-vessel rendering it quite conspicuous in fruit.

Mertensia maritima is found sparingly along the sandy borders of sea-beaches, and has been noted as far west as York, Me.—J. W. Chickering, Jr., *Washington, D. C.*

An erratum.—In the record of Dr. Gray's careful determinations of the Gamopetalæ of Dr. Palmer's Jalisco plants, included in my "Contribution xiv" (Proc. Amer. Acad. xxii), there occurs a single error which I desire to correct. On page 432, under *Cacalia tussilaginoides*, the "ex char." should be erased, leaving the determination, as Dr. Gray intended it to be, "Cacalia tussilaginoides, HBK. Nov. Gen. & Spec. 4.168?" The first reading was as given after his examination of the material in the Kew Herbarium, where he found Coulter's Zimapan specimen, to which he refers as intermediate between Palmer's and the original plant as described by Humboldt and Bonpland. In Paris he found the very specimen upon which the species was founded, but this left him still in doubt as to the identity of Palmer's plant with it. In consideration, however, of the deciduous character of tomentum generally (which in this case is, as described, thin and rather scanty—"folia subtus tenuiter cano-tomentosa") and the tendency of the foliage in *Cacalia* to vary, he deemed it prudent to let his Kew determination stand, and ended his note to me with, "Just print that name with an ?." In correcting the proofs in accordance with his latest conclusions I neglected to dele the "ex char." as I should have done.—Sereno Watson, *Cambridge, Mass.*

Some Indiana plants.—*Viola pedata* L., var. *bicolor* Gray. This handsome variety is found to a limited extent on the sand ridges east of Hammond, Lake county. I have as yet found it in but one locality, near the Michigan Central Railroad, and have transplanted it to the flower garden. It blossomed a second time in the garden the past summer. It was transplanted while in flower, as that is the only time the variety can be distinguished amid the great abundance of the common form, which grows by the acre in the open sandy grounds.

Cnicus undulatus Gray. Sand ridges near Pine Station. The plant is not very canescent, only whitish. It is from one to two feet high, most commonly from twelve to fifteen inches, and usually with a single head. I had noticed this plant for some time, but had passed it by as the common pasture thistle (*Cnicus pumilus* Torr.). But not being quite satisfied with so superficial a determination, and a botanical friend collecting with me having asked its name, in order to be sure of a right answer, it was examined critically, and found to be as above. It is not a matter of surprise to find it in the neighborhood of Chicago, as so many of the plants regarded as belonging farther north come up to the south end of Lake Michigan. It seems less white-woolly than the described form, but in structure of involucre and leaves is identical. In canescence it by no means equals its neighbor, *C. Pitcheri* Torr. The latter grows close by the shore of the lake, in the comparatively naked sand ridges, where the wind has free play, and is often partly buried in the drifting sand, while *C. undulatus* frequents the ridges away from the shore, more or less covered by a variety of plants.

Pogonia pendula Lindl. occurs in the damper grounds amid the pines of the same neighborhood. The flowers are white, or but faintly tinged with pink.

Solanum rostratum Dunal. Near Liverpool, Lake county, by the Fort Wayne railroad. Only a few plants were seen, evidently introduced by the railroad. Should it become thoroughly established, it would be a very troublesome weed, on account of its prickly habit.

Cedar Lake, near Crown Point, has furnished two specimens of Potamogeton that I have not found elsewhere in the vicinity of Chicago, *P. Robbinsii* Oakes, and *P. prælongus* Wulfen. On account of the number of species, the lake is good collecting ground for this genus and other aquatics.

It is not very difficult to find here *Ceratophyllum demersum* L. in fruit, though I have looked for fruit by the hour in other localities. In fact, I have never found it but once or twice in fruit before the summer of 1886.—E. J. HILL, *Englewood, Ill.*

CURRENT LITERATURE.

Origin of floral structures.[1]

This is No. 63 of the "International Scientific Series." There are many figures of flowers and their parts, and many observations on the characters, insect relations and variations of flowers, which have a value quite distinct from that of the theory which is advanced.

Having laid aside the most fruitful principles which have been applied to the elucidation of floral mechanisms, the author goes back to the "monde ambiant" of Geoffroy Saint Hilaire, and undertakes to account for the forms of flowers as the *direct* result of insect agency. Insects stimulate "the flowers till they become thoroughly adapted to their visitors." Conversely, the neglect of insects is "accompanied by corresponding degradations in the perianth, stamens and pollen." The flower, "if it be visited by many, will presumably take a form corresponding to the resultant of the forces brought to bear upon it; if visited by few, it will shape itself in accordance with the requirements of its principal visitors." This considers flowers as developing in a way subservient to the uses of insects, instead of as utilizing them as servants. Adaptations for crossing, being the result of the direct agency of insects, have nothing to do with any advantage resulting from cross-fertilization. The Darwinian theories of natural selection and of cross-fertilization are thus wholly repudiated. But we are so far from being convinced that insects have given rise to useful variations that we even doubt whether they have induced any of the modifications which have been appropriated through natural selection. Moreover, it is easy to show that the characters of flowers are not what they would be expected to be according to the theory. In regard to irregularity he says: "The immediate causes, I repeat, I could recognize in the weight of the insect in front, the local irritation behind, due to the thrust of the insect's head and probing for nectar, coupled with the absence of all strains upon the sides."

But in sternotribe flowers the part which the insect touches the least is the strongest developed. Thus, in Papilionaceæ the banner is quite as large as the two lower petals together, and often as large as the four others, and is largest in those flowers in which it touches the insect the least. The labellum of orchids is a similar case, and its enlargement, instead of being a result of its use as a landing after inversion, is rather the cause of the inversion. The theory involves equal disregard of the function of the expanded parts of flowers and of the conditions under which they were developed. As an example of a flower in the first stage of irregularity, the author cites Verbascum, a descendant of the ancient zygomorphous type of Personales. The two genera with which it forms the

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[1] HENSLOW, REV. GEORGE.—The Origin of Floral Structures through Insect and other Agencies. pp. xx, 350. New York: D. Appleton & Co. 1888.

Verbasceæ are didynamous, and it is evidently of that type. The corolla has become so shallow as to expose the stamens so that insects could light upon them, and the fifth stamen has resumed its antheriferous function. The enlargement of the lower lobe and the unequal length of the stamens, instead of indicating an incipient stage, as the author supposes, refer rather to a former condition. Although it is evident that natural selection must act, at least until after dissemination, we are told, in chap. xxxii, that "the principal period of the struggle for life takes place in the seedling stage, before any varietal and specific characters have appeared." The search for the reason of the author's views is rewarded in this chapter, where we read: "I must confess, it (natural selection) conveys nothing definite to my mind." Having observed that insects have something to do with the forms of flowers, the author is thus under the subjective necessity of referring these forms to their direct instead of their selective influence. However, the book can not be said to be without an important theoretical bearing, since it tends to support the view that but for the principle of selection the theory of evolution would be where Lamarck left it.—R.

NOTES AND NEWS.

A VOLUME on the folk-lore of plants, by T. F. Thiselton Dyer, is announced from the press of Appleton & Co.

THE BOTANISCHES CENTRALBLATT, which has for so long been published by Theodor Fischer, has been transferred to the house of the Gebrüder Gotthelft.

MR. B. FRANK LEEDS reports Euphorbia peplus as spreading rapidly in Santa Clara county, California. E. Lathyris, in the same region, attains a height of six or seven feet.

IT IS interesting to note that one fourth the present membership of the Society for the Promotion of Agricultural Science is composed of botanists, and that so large a part as one-third of the papers printed in the proceedings for 1888 are botanical.

MR. F. H. KNOWLTON has in preparation a manual of palæobotany, which he hopes to have ready for the press by the end of the following year. The work will be illustrated from American material as far as possible, and will give an account of all the orders, and, when possible, the genera, of fossil plants.

THE WESTERN SOCIETY OF NATURALISTS met at the University of Illinois, October 24 and 25. A number of papers were read, relating to the teaching of botany. The following botanists were present and took part in the discussions: J. C. Arthur, Purdue University; W. J. Beal, Agricultural College of Michigan; T. J. Burrill, University of Illinois; D. H. Campbell, Indiana University; John M. Coulter, Wabash College; Stanley Coulter, Purdue University; Thomas McBride, Iowa University; W. H. Hatch, Rock Island; Charles Robertson, Carlinville, Ill.

FINE SPECIMENS of silicified wood (unnamed), suitable for cabinets and for microscopic study, have been sent us by Mr. Edgar Cherry, of Santa Rosa, California. He speaks of a petrified forest thirteen miles from Santa Rosa, covering twenty acres, and containing many large tree trunks in excellent preservation.

REV. A. B. HERVEY, of Taunton, Mass., recently became president of St. Lawrence University, Canton, N. Y. He is the author of "Sea mosses: an introduction to the study of marine algæ," and has, from time to time, rendered botany good service by translating works from the German. We hope his new duties will not draw his attention away from botanical pursuits.

DURING THE PAST season, Mr. F. H. Knowlton has been collecting fossil plants in the National Park, and has had excellent success. He writes of some slabs of stone a foot square containing half-a-dozen or more perfect leaves, ferns *in fruit*, and other prizes. In addition to the collections of fossil plants, he found time to gather living species, some of which are new to science.

MR. PETER HENDERSON, the well-known seedsman and florist of New York city, holds the opinion that a knowledge of general botany is of special service to the floriculturist, and emphasizes his conviction by offering a prize of $100 for the best herbarium of native plants presented by a member of the Society of American Florists. The prize is to be awarded at the annual meeting of 1889.

EBERDT has reinvestigated the conclusions heretofore reached as to the influence of light in the formation of the palisade parenchyma of the leaf. In opposition to the statement of Stahl, the writer agrees in the main with Haberlandt, that it is less the sunlight which brings about the formation of the palisade than the variation in assimilation and transpiration. Especially is this true of the land plants, in which he concludes the illumination is unimportant except as it determines these other functions. (See abstract in Bot. Centralblatt, xxxv, 332.)

VERY COMPLETE herbarium specimens, including fruits and seeds, accompanied with dissections, both dry and in alcohol, are being prepared by M. Buysman, of Middelburg, Holland, and sold at twenty cents each, or forty cents for tropical species. Sets will be arranged to meet the wishes of purchasers. Mr. Buysman has been preparing and distributing such collections for some time, and his work has been commended by such eminent botanists as Professors Morren, de Bary, Engler, Oudemans and Rauwenhoff. He will be glad to correspond (in English) with any person willing to supply material for the distribution. Reasonable compensation is offered for fine material.

IN THE REVISED Gray's Manual, which is to be ready for the press next month, is to be included a revision of the Hepaticæ by Dr. Lucien M. Underwood. This will be of great advantage to students, as it will make more accessible diagnostic descriptions of these interesting plants, and, we hope, encourage their collection and study. There will be considerable changes from the "Catalog" published by the Illinois Laboratory of Natural History for Dr. Underwood some years ago, as much material has been accumulated since then. We wish a similar revision of the mosses might have been included. They can hardly be said to be suitably provided for by the Manual of Lesquereux and James.

Dr. Alfred Fischer has demonstrated in an important research on various species of trees that glucose is a constant form of reserve material. The uniform statement of the text-books heretofore has been that all the glucose is transformed into starch for storage. But a study of twigs of trees in winter, using Fehling's solution, demonstrates clearly the presence of glucose. It is especially abundant in the cortex, but occurs also in the wood and pith. It is found either in dead cells (*i. e.*, those which have lost their protoplasm), or in the cell walls. It does not occur in living cells. Dr. Fischer is of the opinion that it must be considered as material which has escaped, by its presence in these places, transformation into starch. For the paper, see *Botanische Zeitung*, xlvi, 405.

M. Prillieux has announced to the French Academy of Sciences (Comptes Rendus, cvii. 447) the successful issue of an experiment with "Bordeaux mixture"—a watery solution of sulphate of copper and lime—in the treatment of the potato-rot. Of the treated plants all the tubers were healthy, while of the untreated more than 32 per cent. were affected. It would seem from the tenor of M. Prillieux' note that this was the first successful experiment in this direction; but this is not borne out by the report of Prof. Scribner for 1887 (Department of Agriculture, p. 331), which indicates the publication in 1886 of experiments which were at least encouraging. The department therefore sent out a circular suggesting the trial of this remedy for the rot, but received no replies.

DeVries has suggested[1] a new application of his well known method of plasmolysis, which may prove of much use to chemists in settling the formulæ of organic substances. The method is essentially the determination of the molecular weight of an unknown substance by comparing its plasmolysing power with that of some substance whose molecular weight is known. DeVries illustrates the process by determining the molecular weight of "raffinose," a sugar discovered in 1876, and for which three possible formulæ have been given. Solutions of cane sugar were prepared of definite strength, and likewise of raffinose. The purple epidermal cells on the under side of the leaf of Tradescantia discolor were used as an indicator. On comparing the isotonic coefficients of the substances, a molecular weight of 595.7 was obtained for raffinose. This agrees almost exactly with the weight assigned by one of the formulæ, viz., 594, and settles the composition as $C_{18}H_{32}O_{16}$.

Prof. Halsted, of the Agricultural College, Ames, Iowa, is prosecuting a special study of American weeds, and desires reports upon the worst (say twenty) of these plant pests in any given locality. A full list of the synonyms of common names for each species will add greatly to the value of the report. It will, of course, be no easy task to balance the points in favor of, and against, some kinds of weeds, but upon this account the deductions from the several reports will be all the more valuable. The work of determining the range, extent of injury, and methods of eradication of our weeds must depend largely upon local observations extended over long periods of time, and we trust our fellow botanists and other interested readers will gladly aid in furnishing the desired information. Any one having a duplicate local printed list of plants or of a county or even a state, can most readily answer the question, Which are your worst weeds? by checking off the species, beginning with one (1) for the worst, and so on as far as possible. Satisfactory credit will be given to all who are pleased to aid in a more complete knowledge of the weeds of America.

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[1] Bot. Zeit. xlvi. 393.

THE PROCEEDINGS of the Society for the Promotion of Agricultural Science for the 1888 meeting have been distributed. The botanical subjects are as follows: Flora of the jack-pine plains of Michigan, by W. J. Beal, chiefly an enumeration of seventy-two of the most characteristic species of that region; Notes on fungus diseases in Massachusetts in 1888, by W. G. Farlow—an account of the first appearance at Newton, Mass., the present year, of Sphaceloma ampelinum, the anthracnose of the grape, and its destructive character, of the alarming extension of the hollyhock disease, Puccinia Malvacearum, since its first appearance in 1886, also notes on Peronospora viticola and Æcidium Fraxini; in the two topics, Potato flowers and fruit, and Tomato flowers and fruits, B. D. Halsted notes the sparsity of pollen in some varieties of potatoes, and the uniformity of the number of parts of the tomato flowers on the same plant with the slightly less number of cavities in the fruit; Some preliminary notes upon the relation of our native and naturalized flowering plants to soil and climate, by W. R. Lazenby; New observations on the fungus of black rot of grapes, and Successful treatment of black rot, by F. L. Scribner: A further study of the dandelion: a phase of evolution, by E. L. Sturtevant; to which may be added G. C. Caldwell's paper on the Present aspects of the question of the direct utility of the free nitrogen of the atmosphere for plant food.

DR. ISTVANFFI, of Klausenburg, describes (Bot. Centralblatt, xxxv, 343) methods for preparing various sorts of fungi. In alcohol one can preserve smaller fungi which are desired only for microscopic researches, Gasteromycetes most Ascomycetes, of the Hymenomycetes the colorless Agaricineæ and Polyporei but never the Boleti, and the Hydnei, Clavariei, Theliphorei and Tremellini. Salt water preserves the color and form better than alcohol, but preserves only for a short time. In addition to this fluid, a 0.1 p. c. solution of corrosive sublimate and a 2 p. c. solution of boric acid have been found useful. But the most difficult to preserve are the large Agaricineæ. For these the writer describes in detail the "section method." These fungi are best collected in clear weather immediately following a rain. They should be prepared the same day as collected, or, if this is not possible, they may be preserved for one or two days by being placed between moss under a bell jar. Spore preparations are to be made in the well-known way, and fixed by floating the paper, in the case of dark-spored species, in a fixative made of alcohol (200 gm.), sandarac (5 gm.), mastic (10 gm.) and Canada balsam (10 gm). In the case of the white-spored species, the fixative should be sprayed on with an atomizer, or they may be floated in a solution of ½ gm. of cooking-gelatin in 100 gm. of 20 p. c. alcohol, kept warm on a water bath. For the reception of the sections a gelatinized paper is to be prepared. For this purpose dissolve 100 gm. of gelatin in 500 gm. of water, and spread the hot solution as thickly and evenly as possible on strong white paper; dry the paper on a line and keep under pressure. A longitudinal section through the center of the fungus (0.5-1 mm. thick) is laid upon the paper after first moistening it. The whole of the membrane of the pileus and that of the stipe are also mounted on the paper after removing the flesh. The sections are then dried as ordinarily. For further details the paper must be consulted. Compare also this journal, xii. 271.

GENERAL INDEX.

Names of new species are printed in **Bold-Face** type; synonyms in *Italics*; † signifies death.

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ERRATA.

Page 5, last line, for "1877" read 1887.
Page 9, lines 3 and 5 from bottom, for "Gothic" read L.
Page 16, line 10 from top, for "penicellata" read *penicillata.*
Page 35, line 7 from top, for "ags" read *gas.*
Page 37, after P. heterosperma insert *n. sp.*
Page 40, line 4 from top, for "Schenck" read *Schneck.*
Page 68, line 3 from bottom, read *development and morphology of.*
Page 68, after foot-note 7, insert *p.* 595.
Page 132, line 8 from top, for "Cockrell" read *Cockerell.*
Page 147, foot note 7, for "Tropœlum" read *Tropæolum.*
Page 164, line 10 from bottom, for "Engelman's" read *Engelmann's.*
Page 172, line 18 from bottom, for "pest" read *host.*
Page 175, line 18 from bottom, for "Sablou" read *Sablon.*
Page 200, line 7 from top, for "Crowdin" read *Crowder's.*
Page 218, line 5 from top, for "Schenk" read *Schrenk.*
Page 218, line 14 from top, for "Aug. 10" read *Aug.* 3.
Page 251, foot-note for "w" read *wiss.*

DR. W. PFEFFER,

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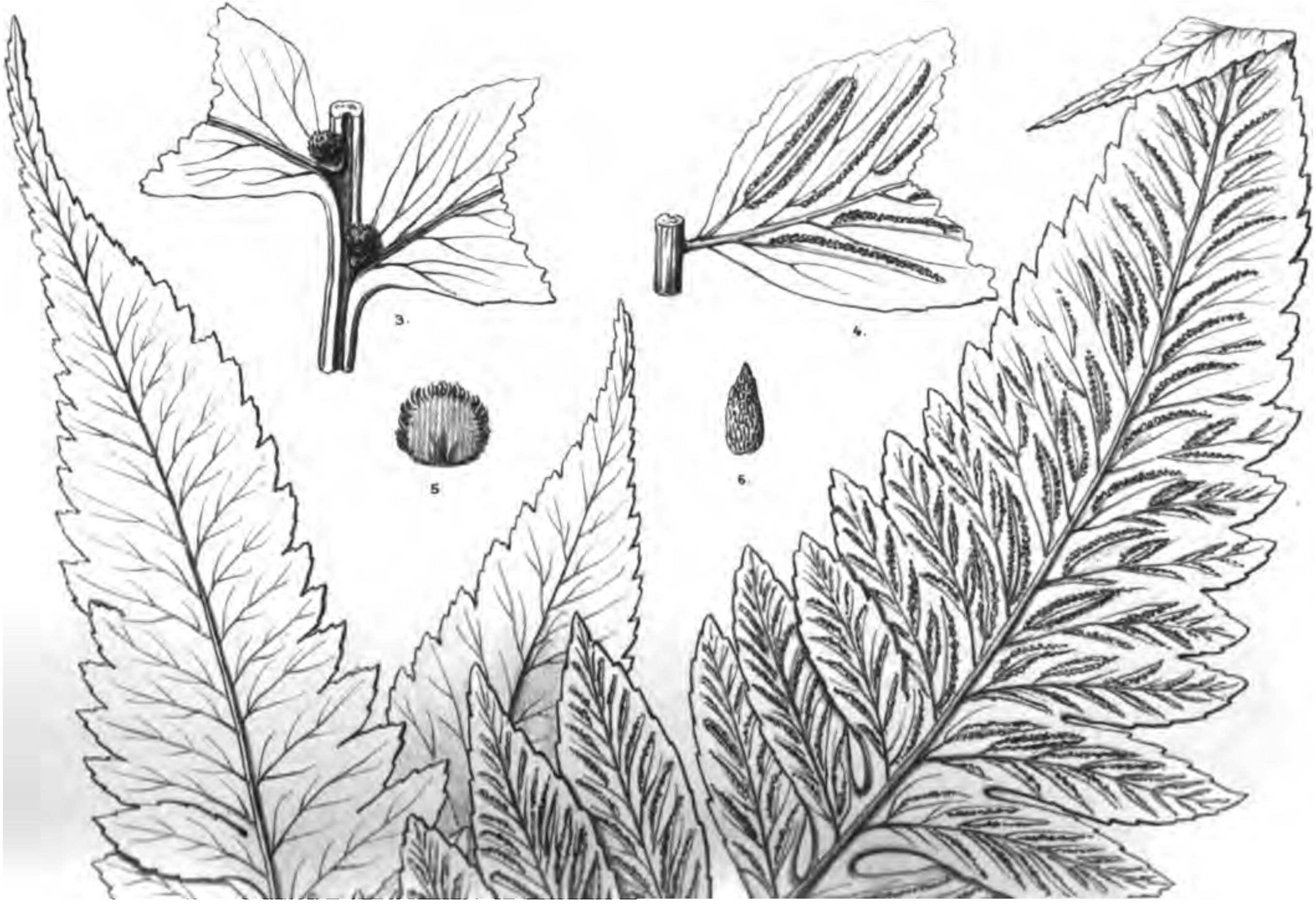

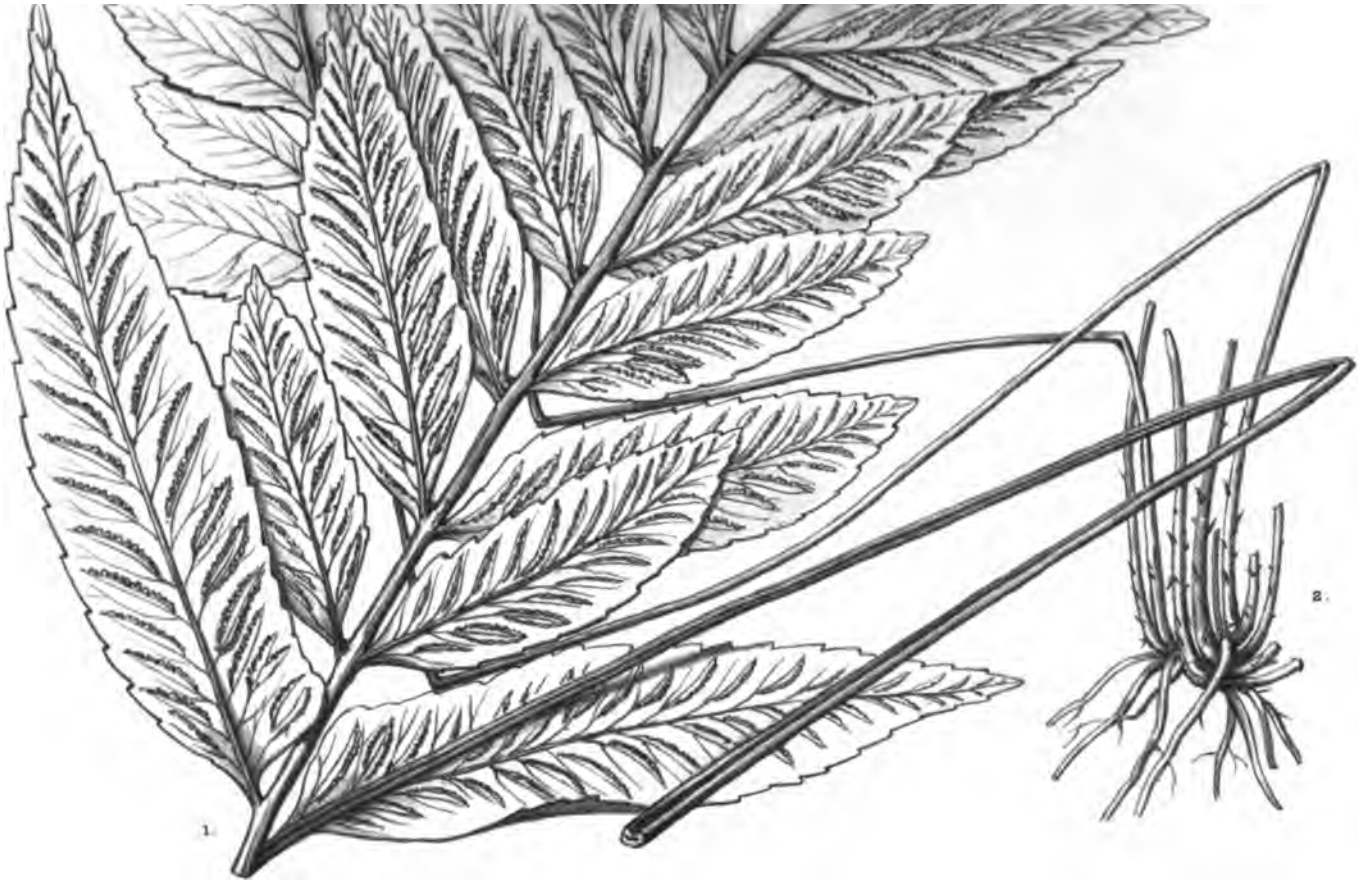

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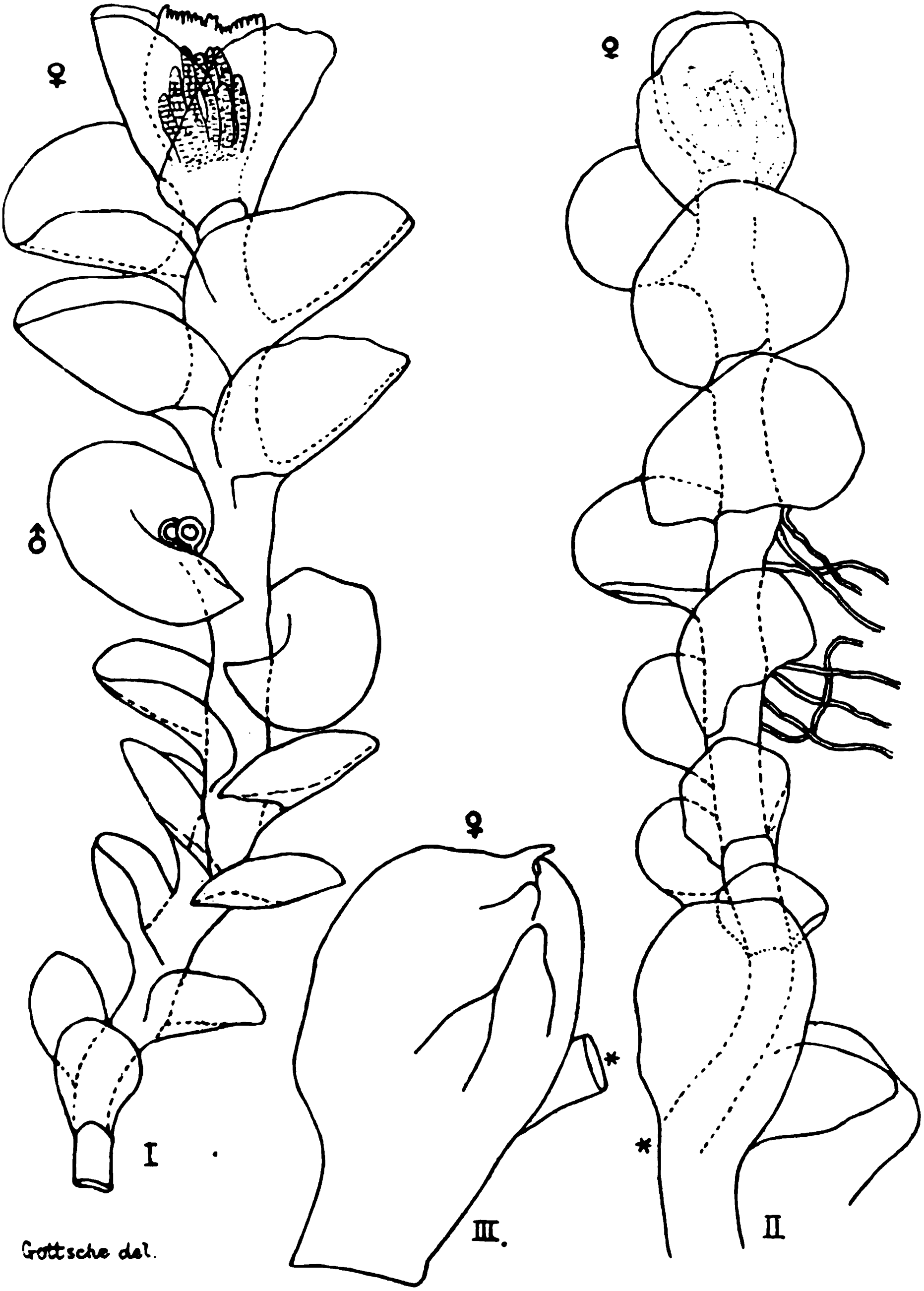
Plate III



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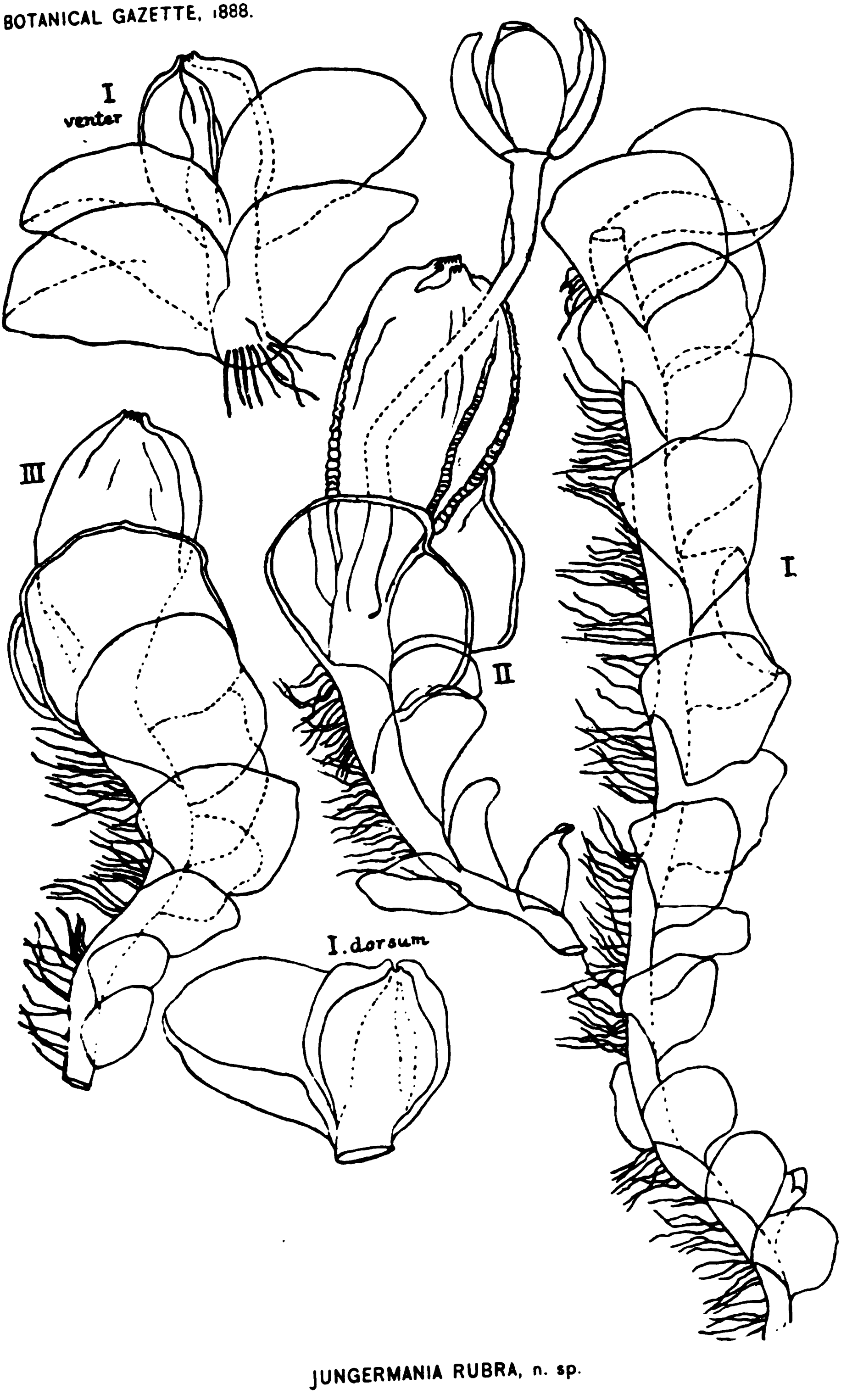

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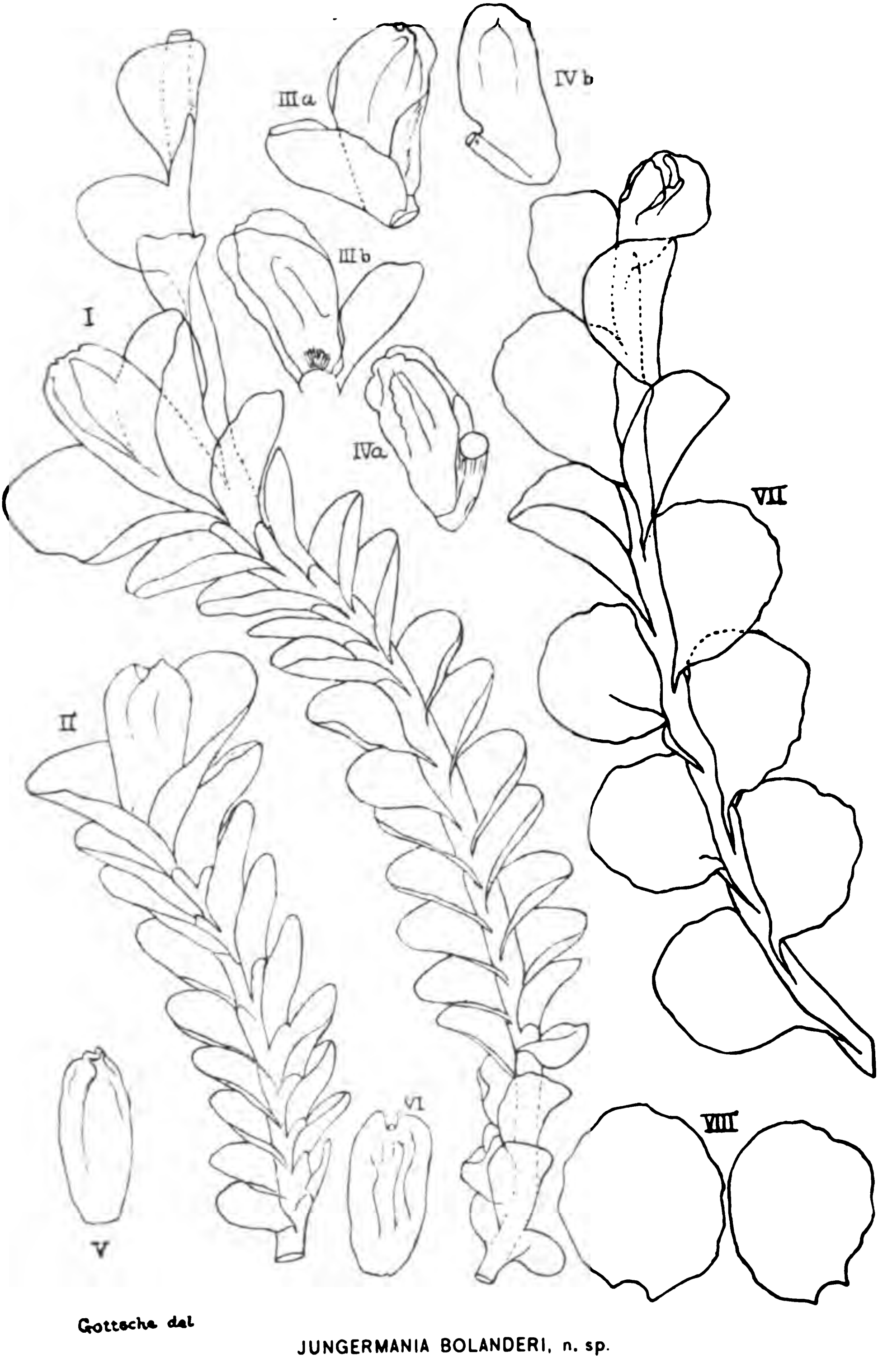

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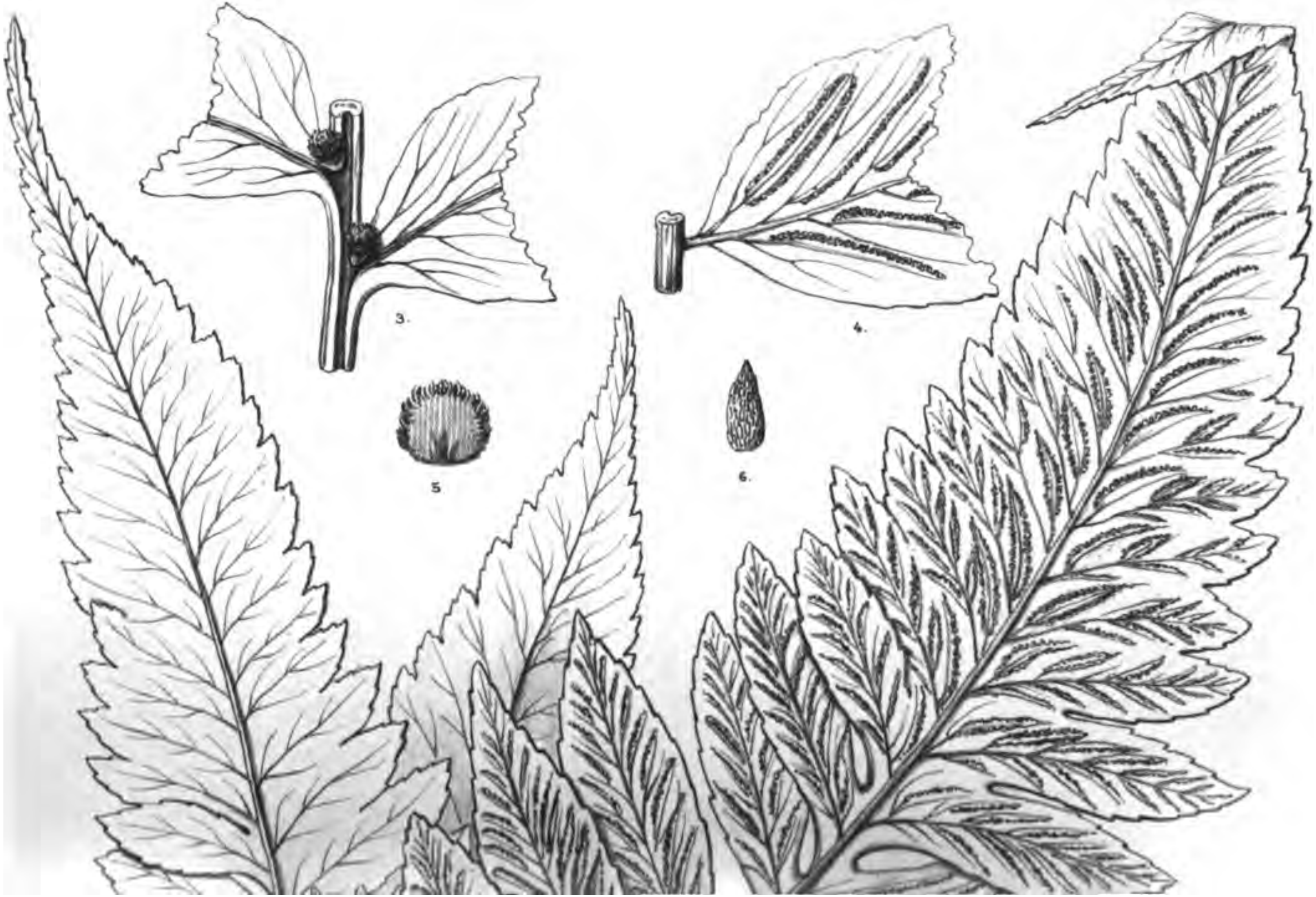

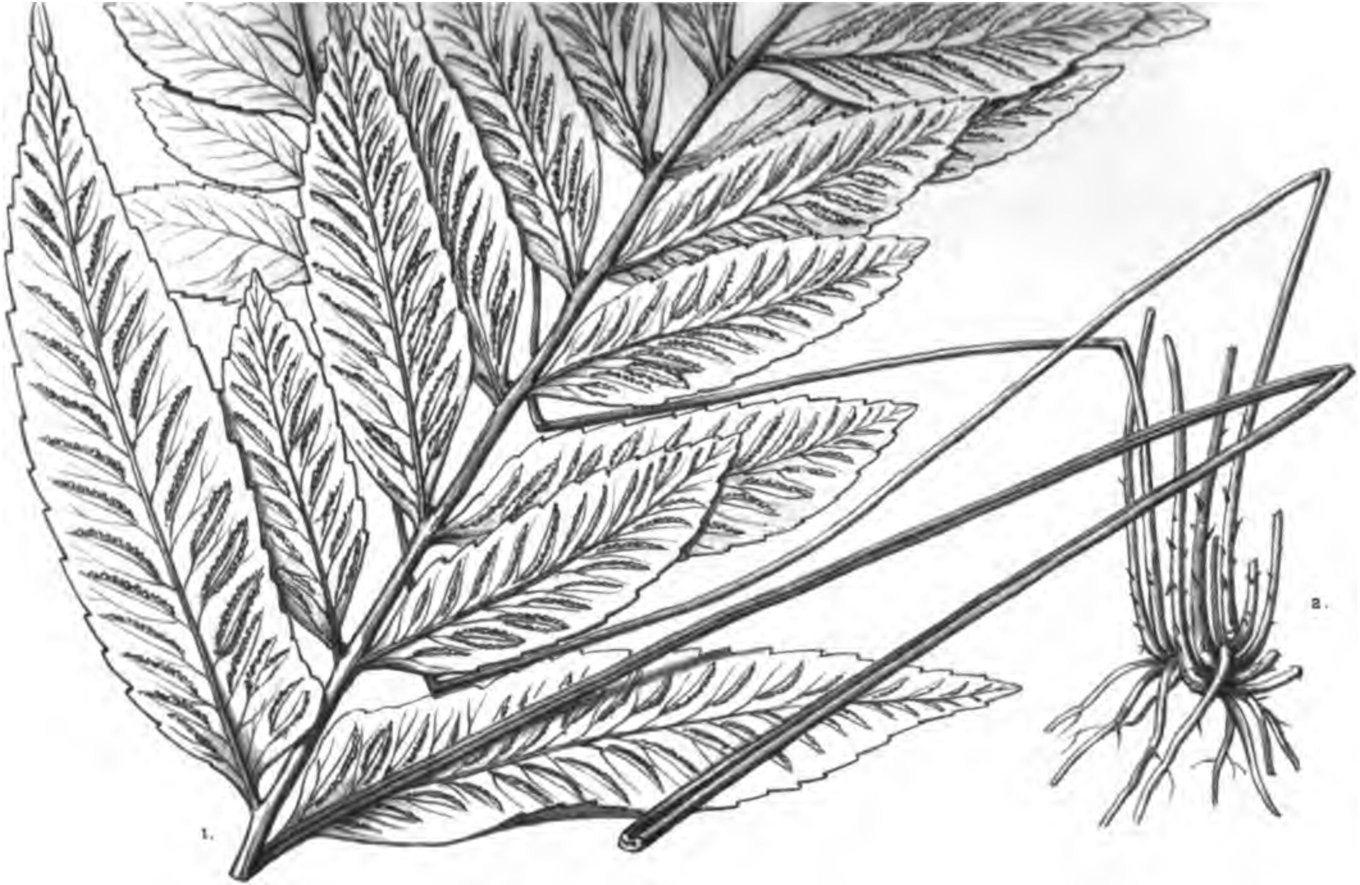

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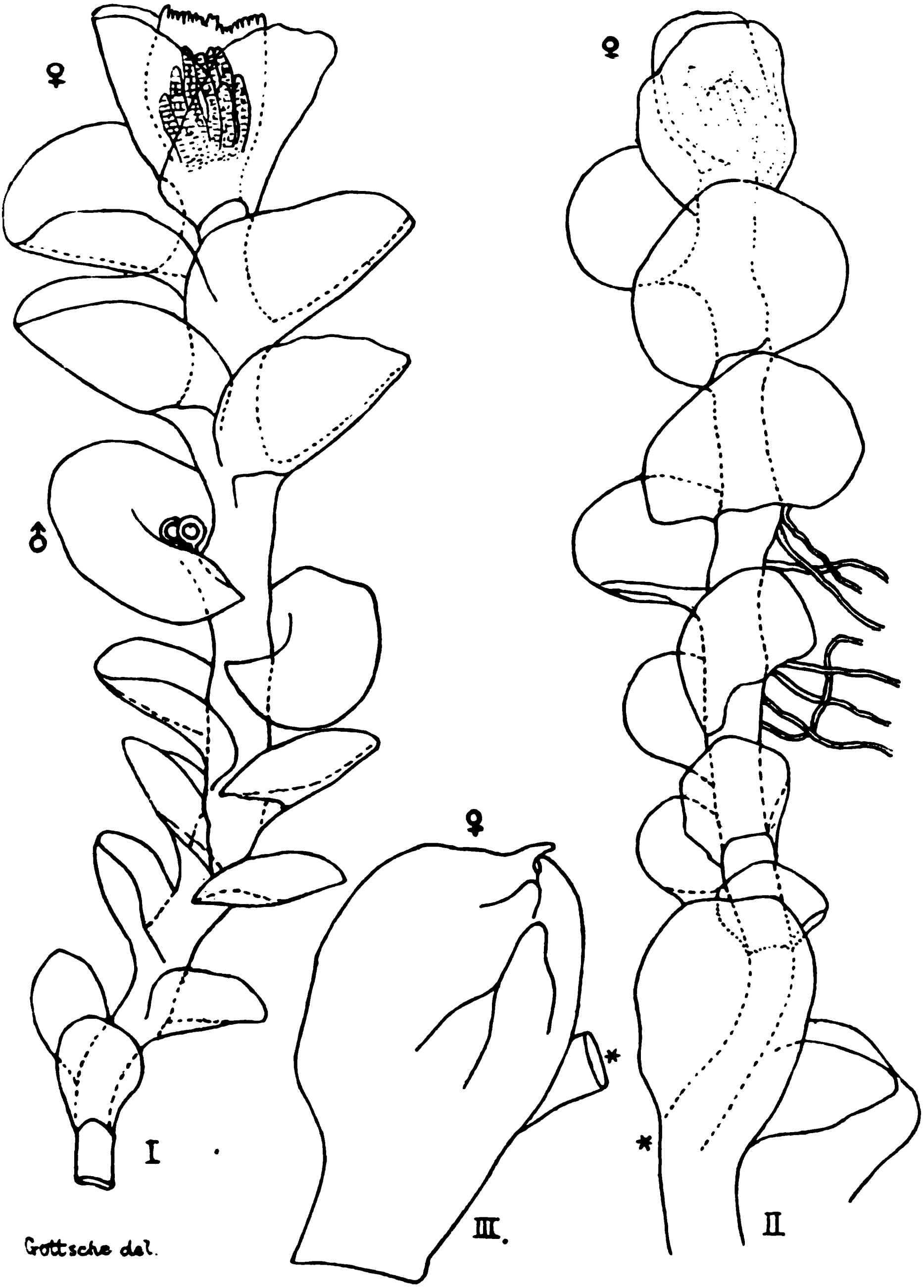

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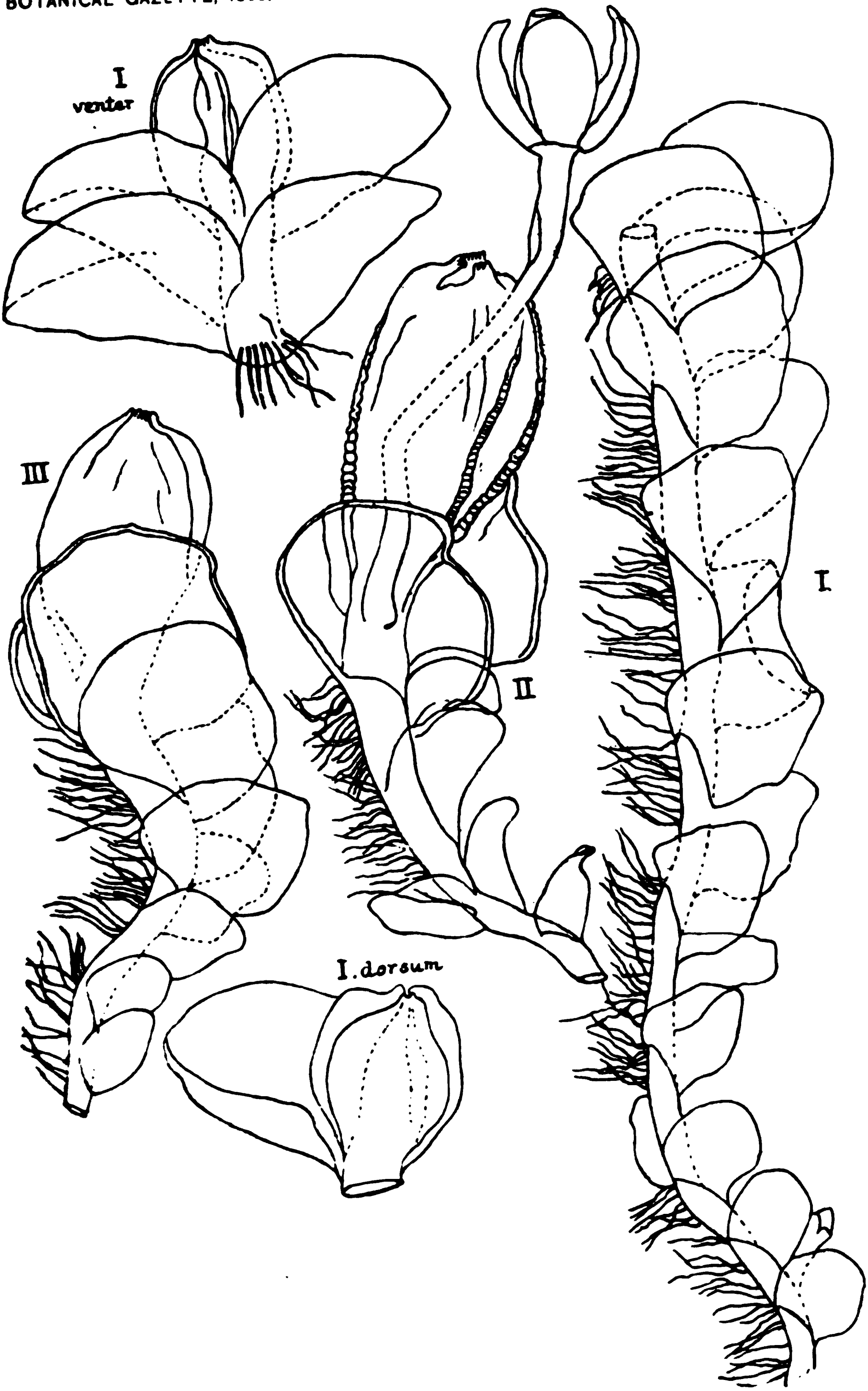
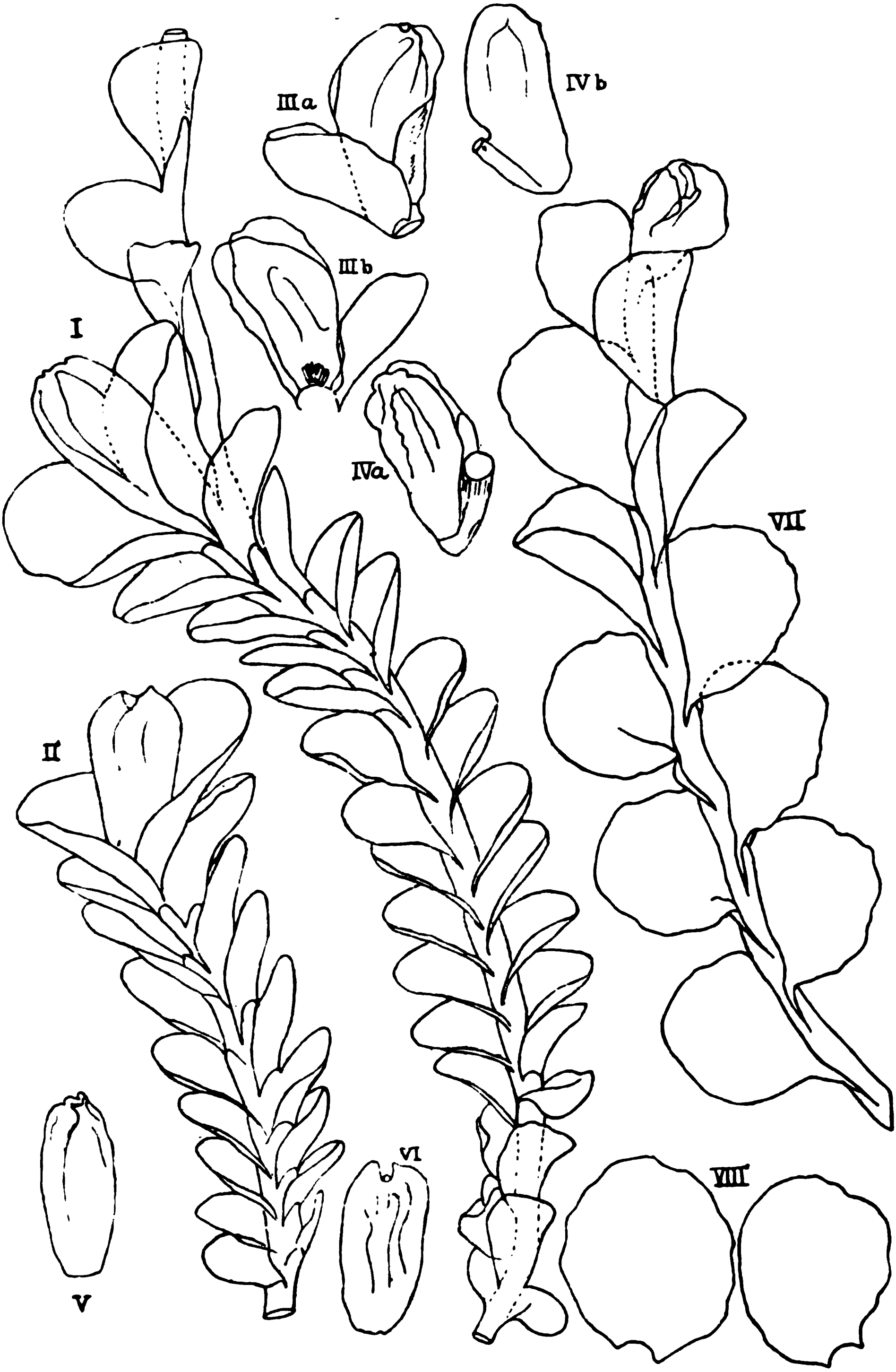
JUNGERMANIA DANICOLA, n. sp

Plate IV.

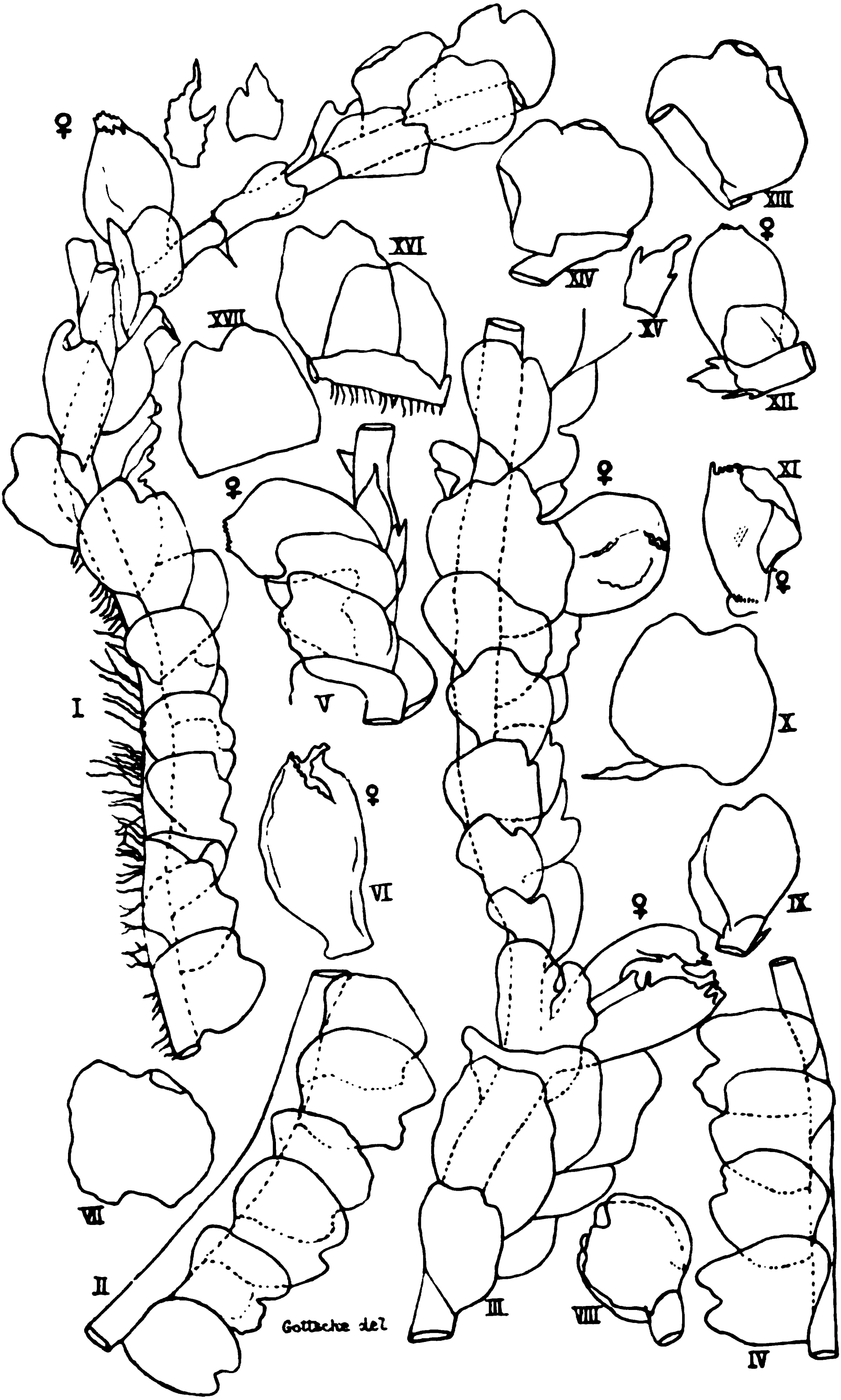


JUNGERMANIA RUBRA, n. sp.

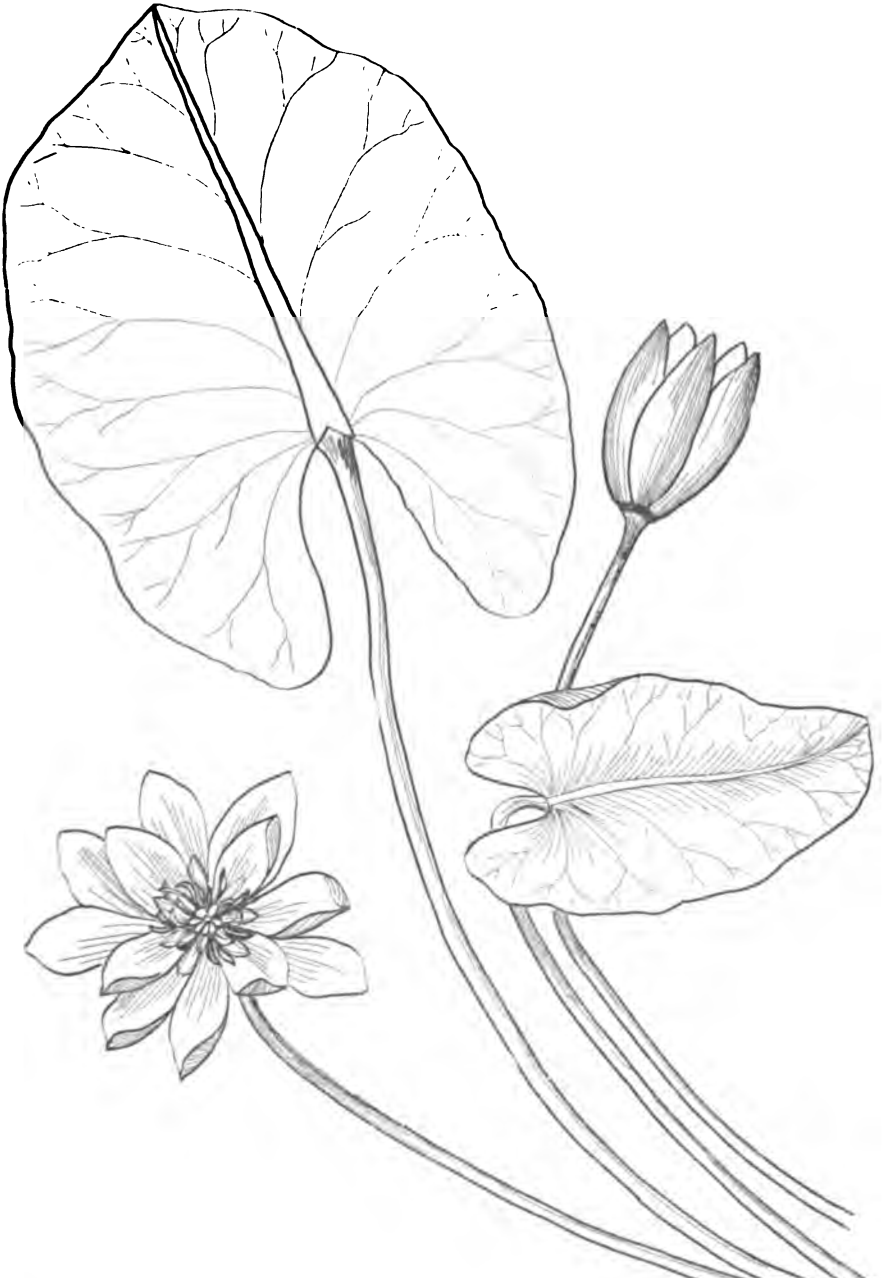


Gottsche del

JUNGERMANIA BOLANDERI, n. sp.

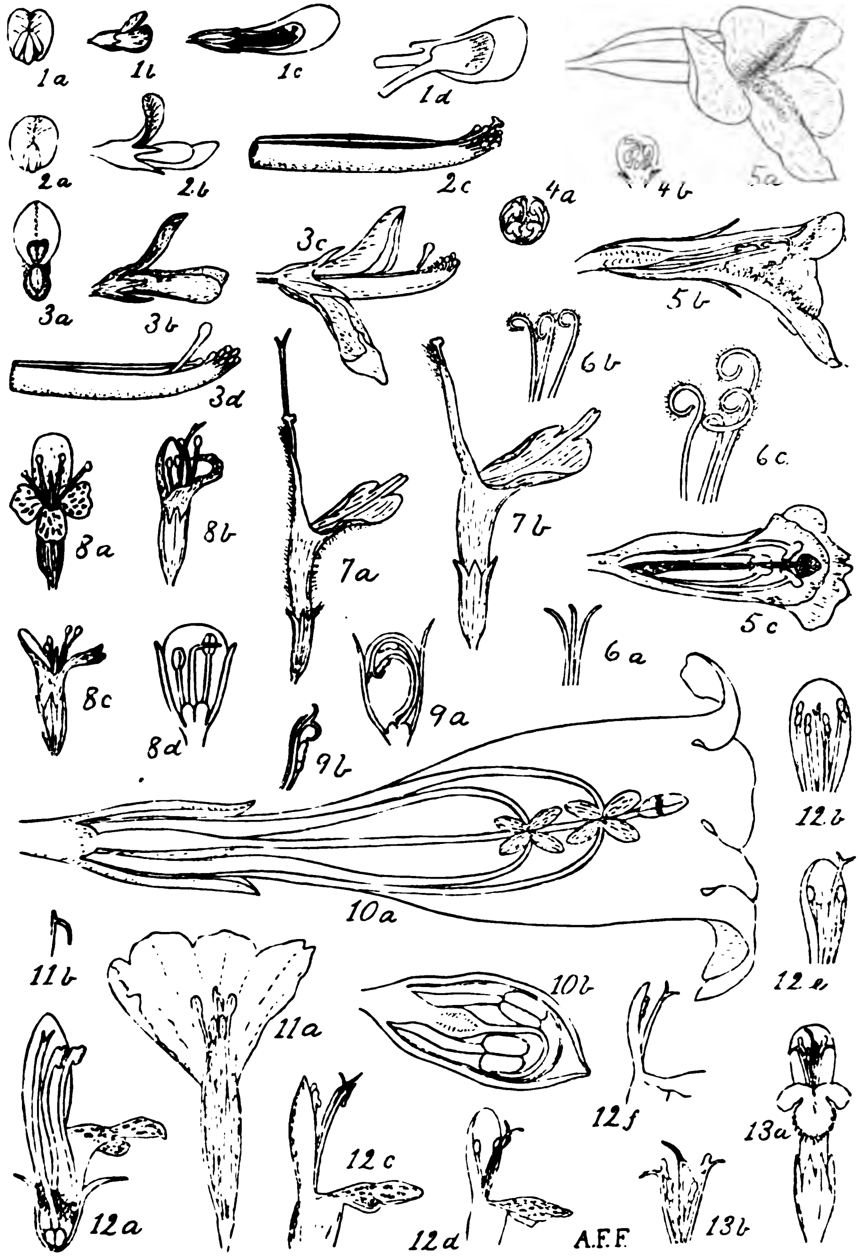


JUNGERMANIA MUELLERI, var. DANAËNSIS, n. var.

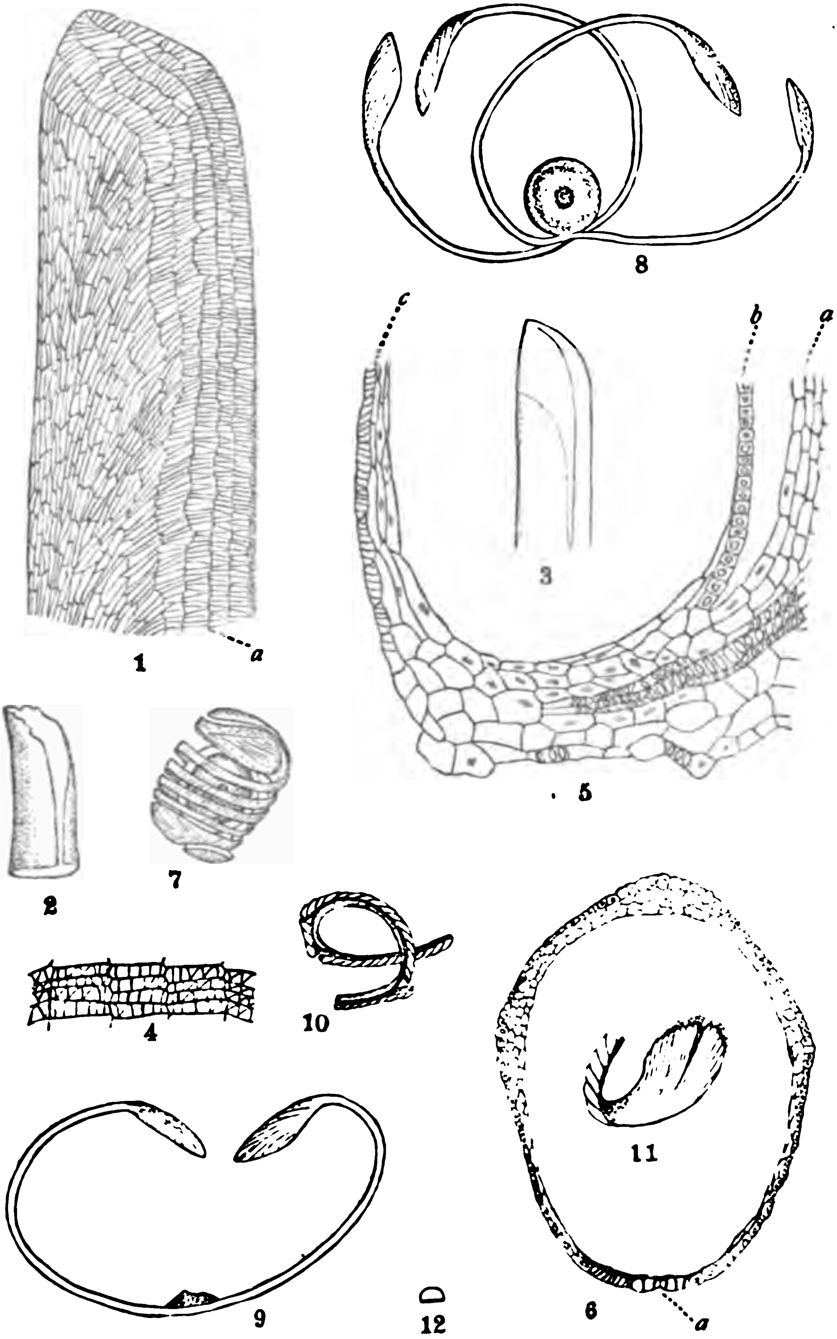


CASTALIA LEIBERGI, n. sp.

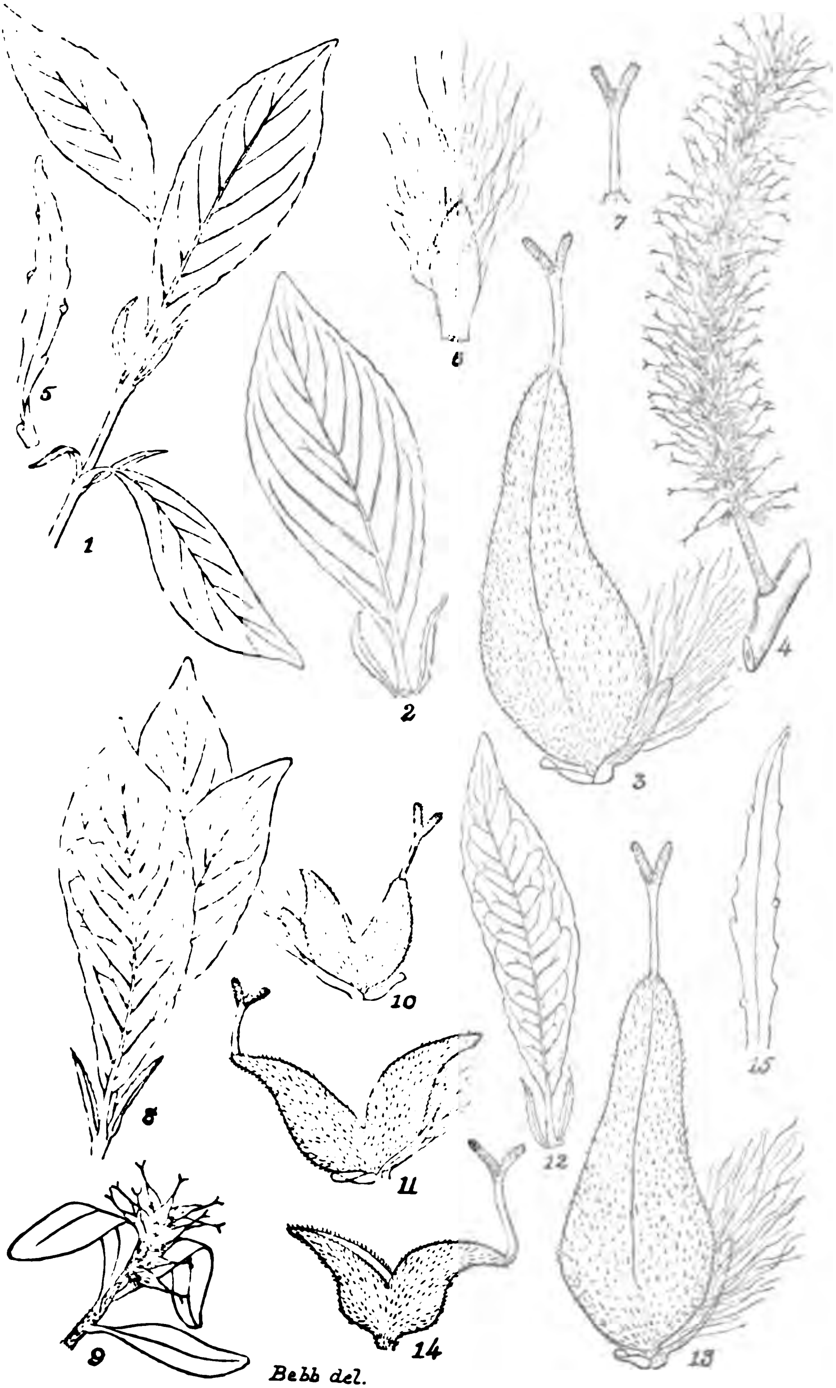
BOTANICAL GAZETTE, 1888. Plate VIII.



FOERSTE on CROSS-FERTILIZATION.



NEWCOMBE on SPORES OF EQUISETUM

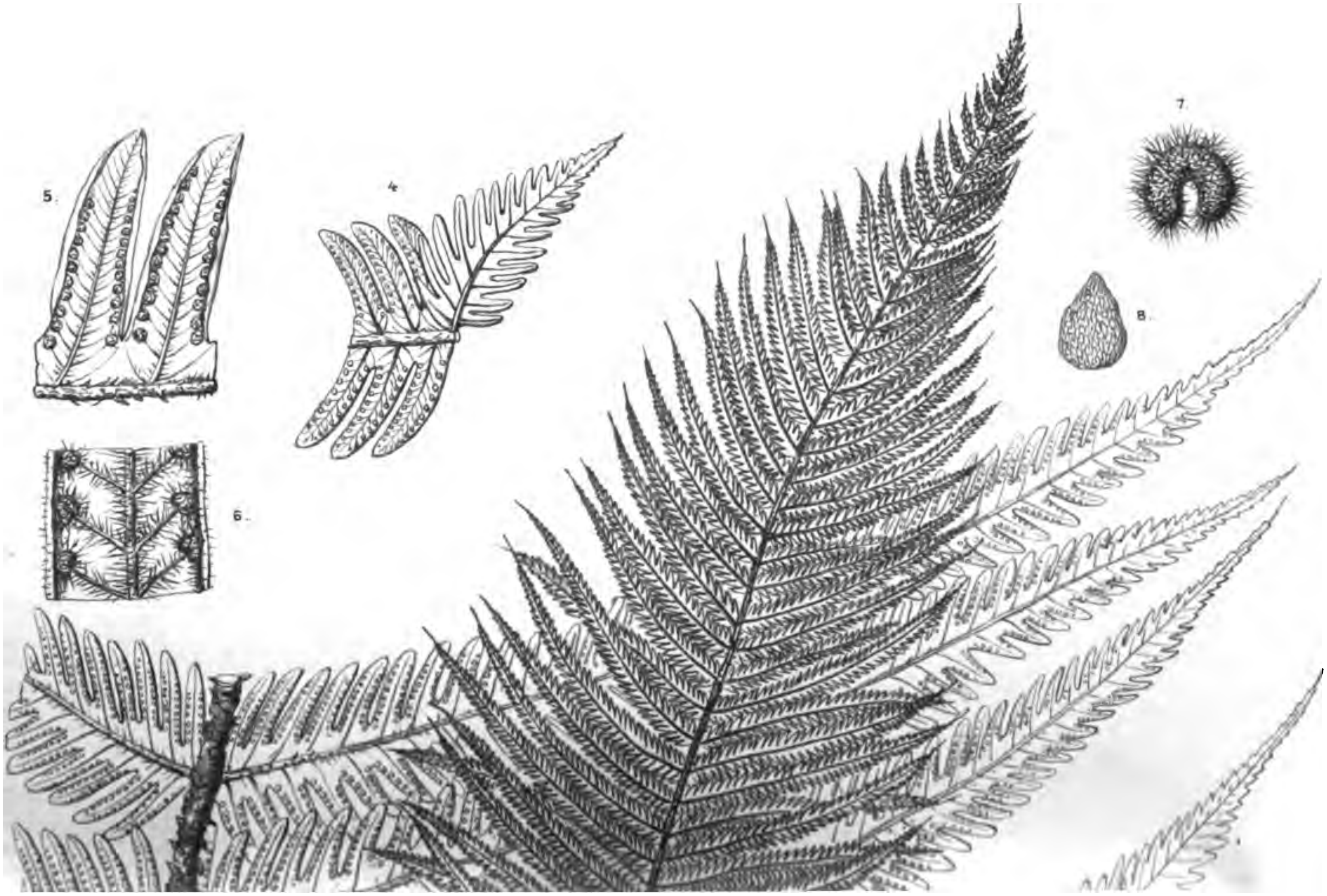


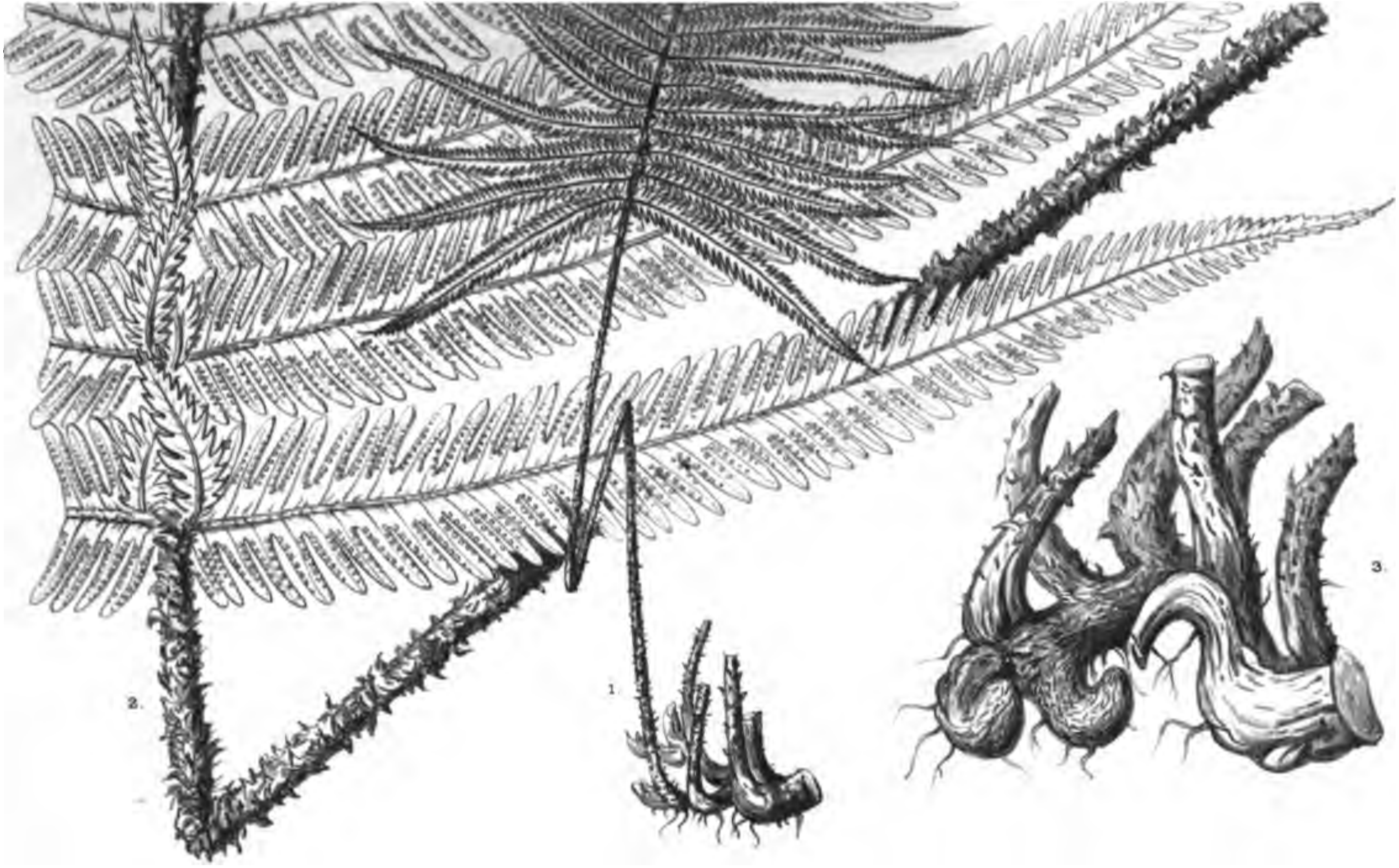
Bebb del.

BEBB on SALIX PHYLICOIDES AND.

Botanical Gazette, 1888.

Plate XI.

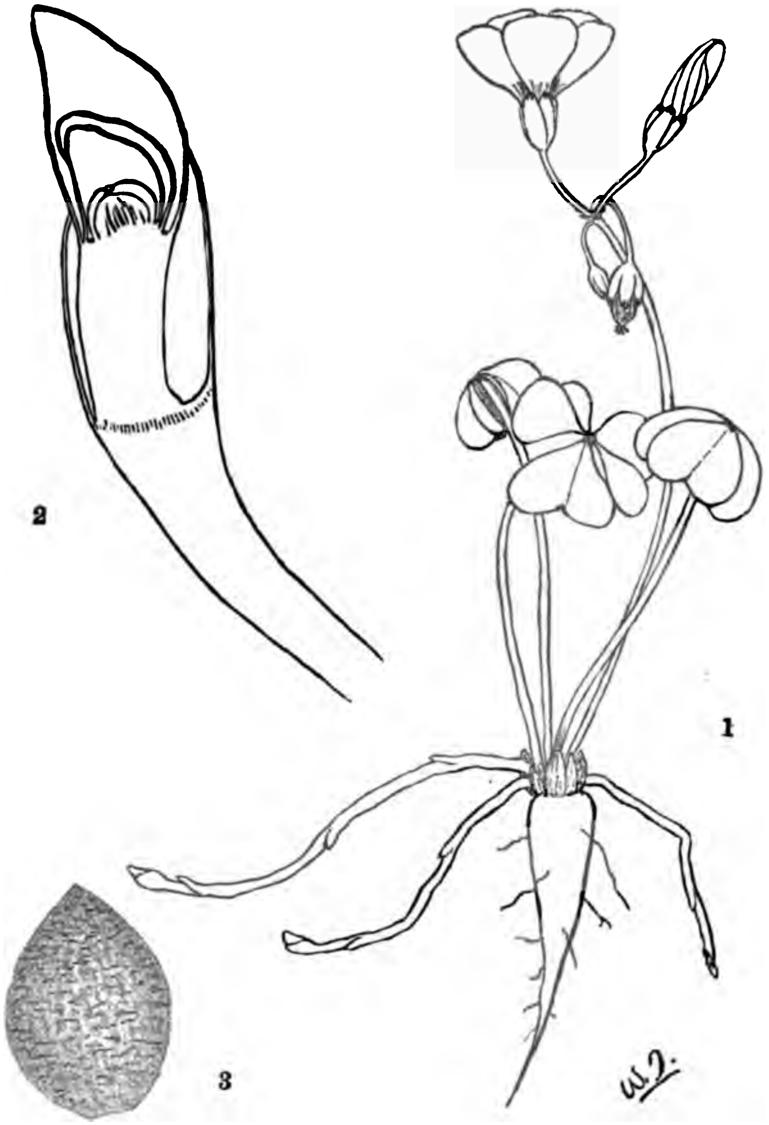




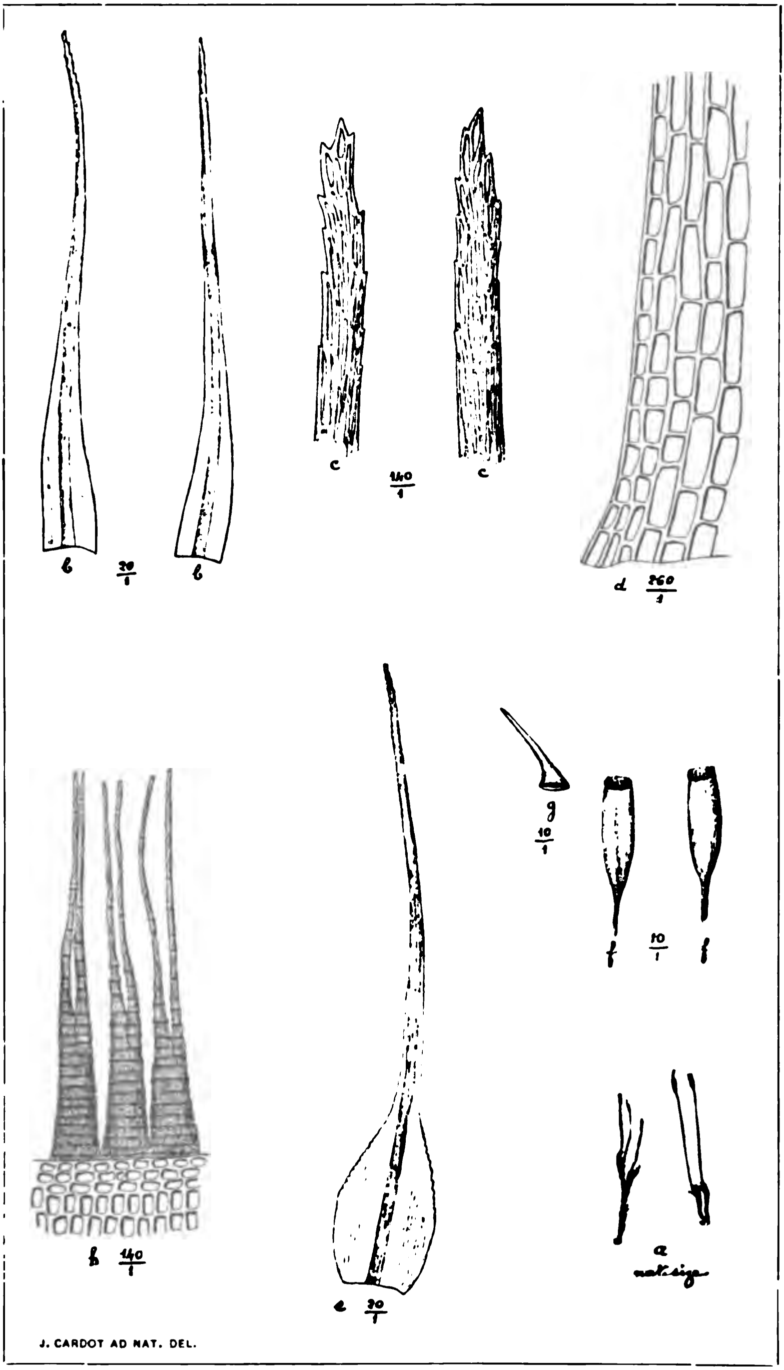
C E Faxon del

B Meisel, Lith Boston

NEPHRODIUM TUERCKHEIMII, J Donnell Smith.

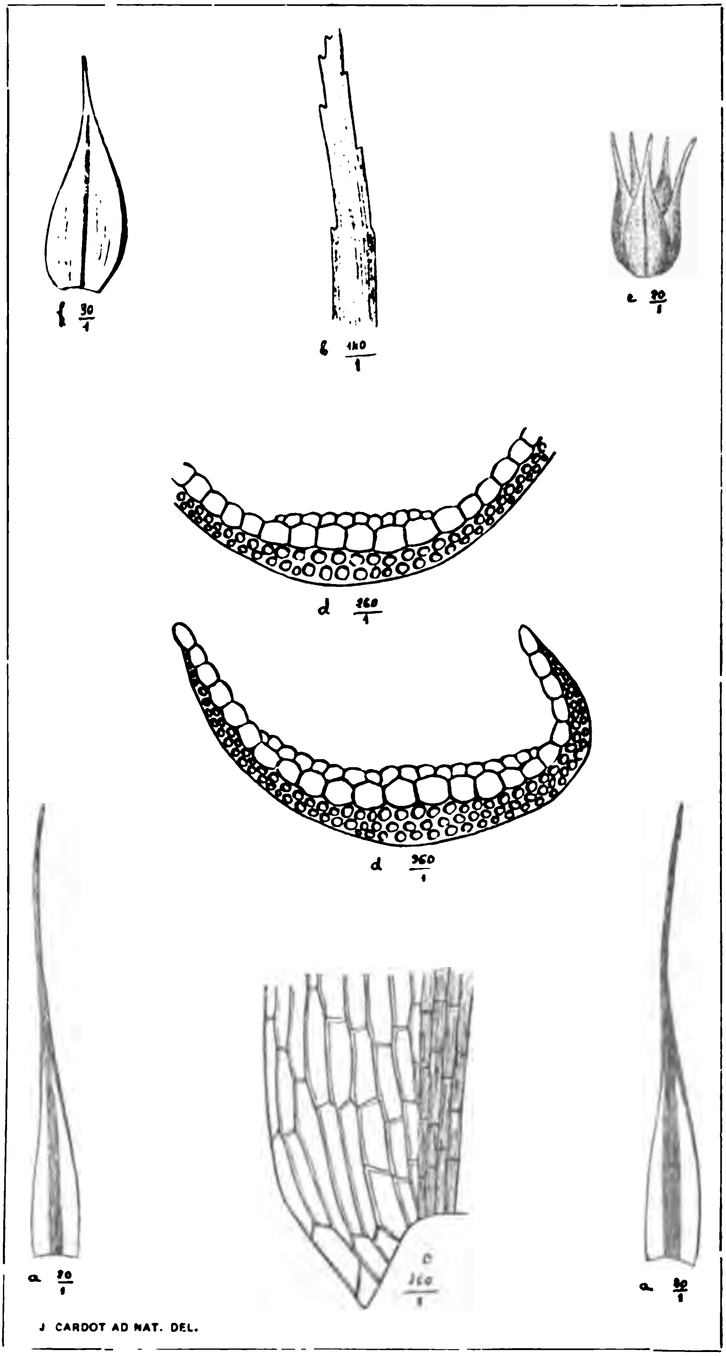


TRELEASE on OXALIS.



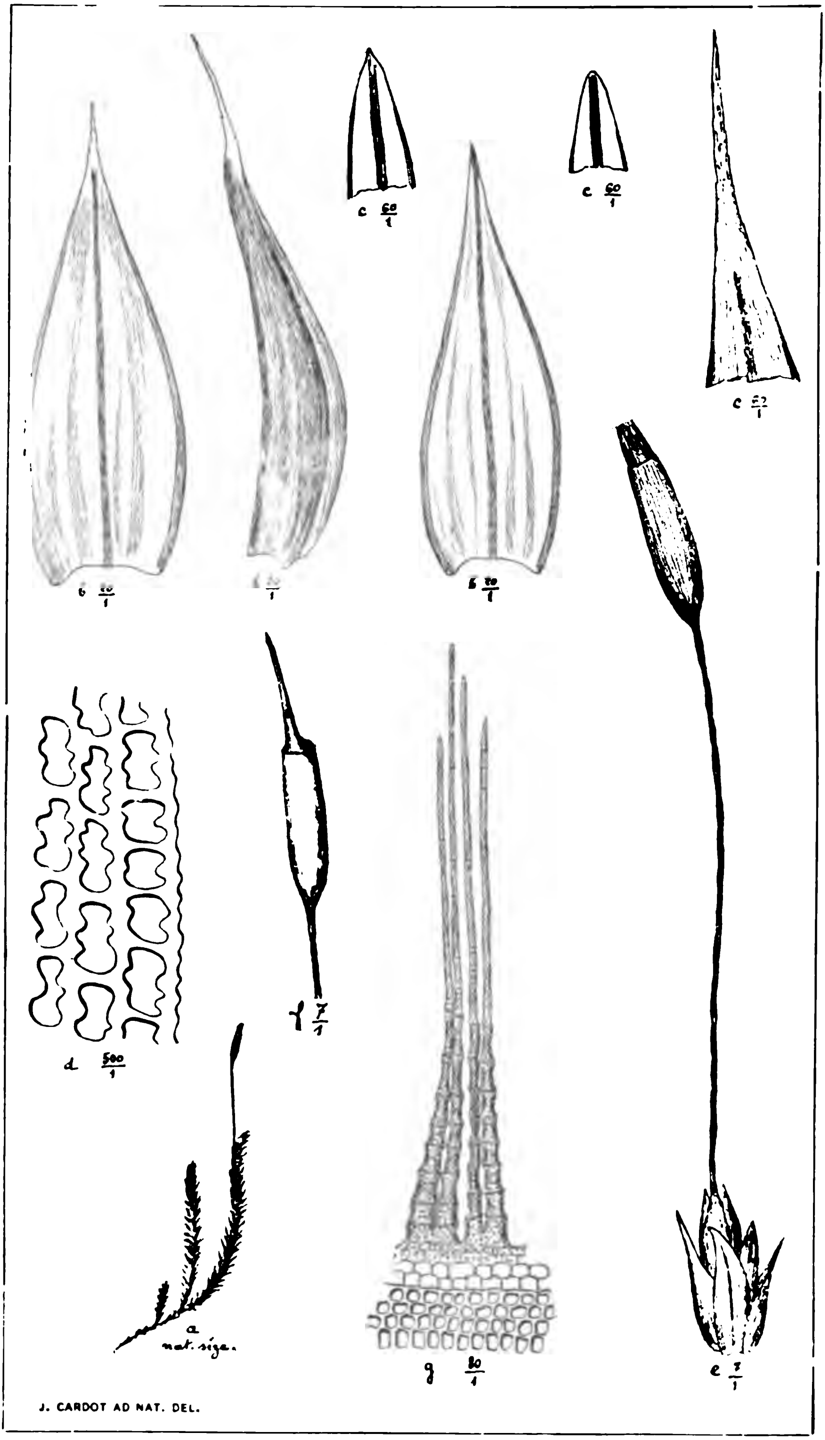
J. CARDOT AD NAT. DEL.

DICRANELLA FITZGERALDI.



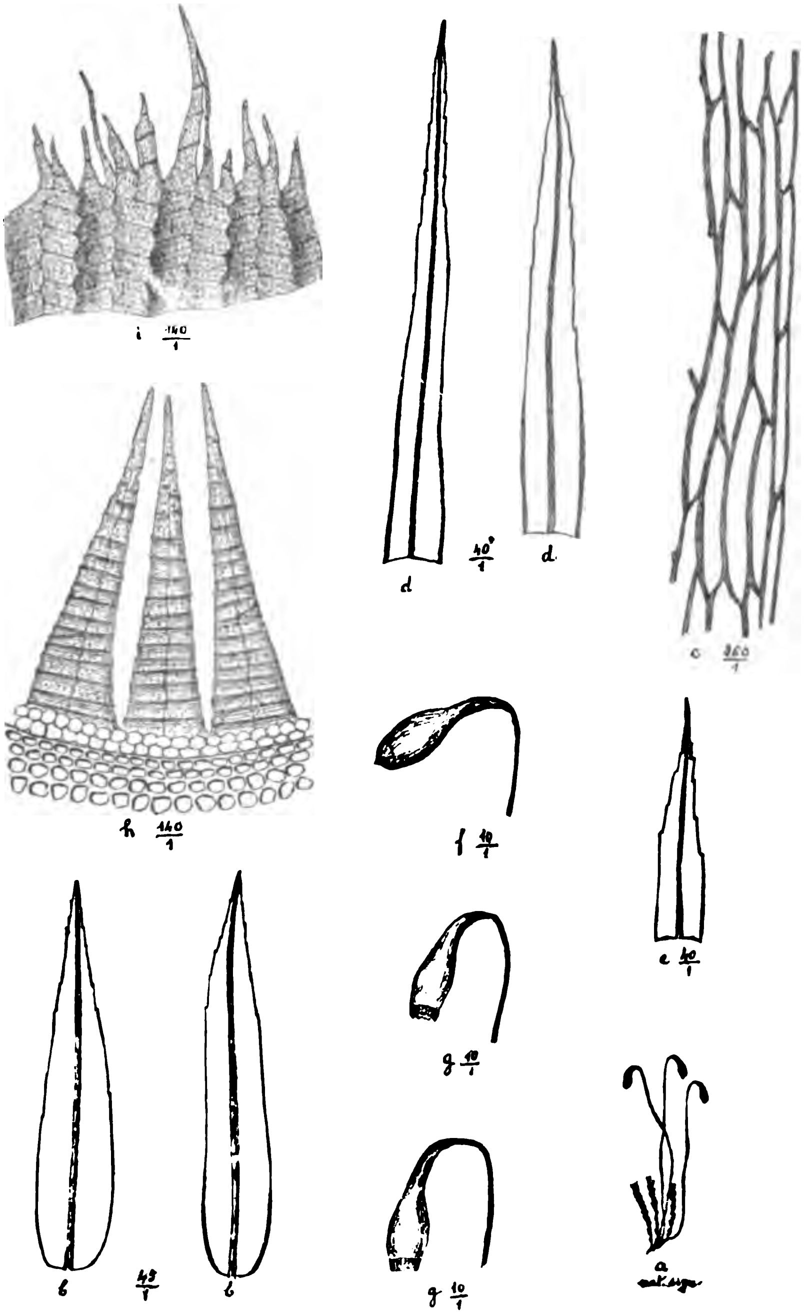
J CARDOT AD NAT. DEL.

CAMPYLOPUS HENRICI.



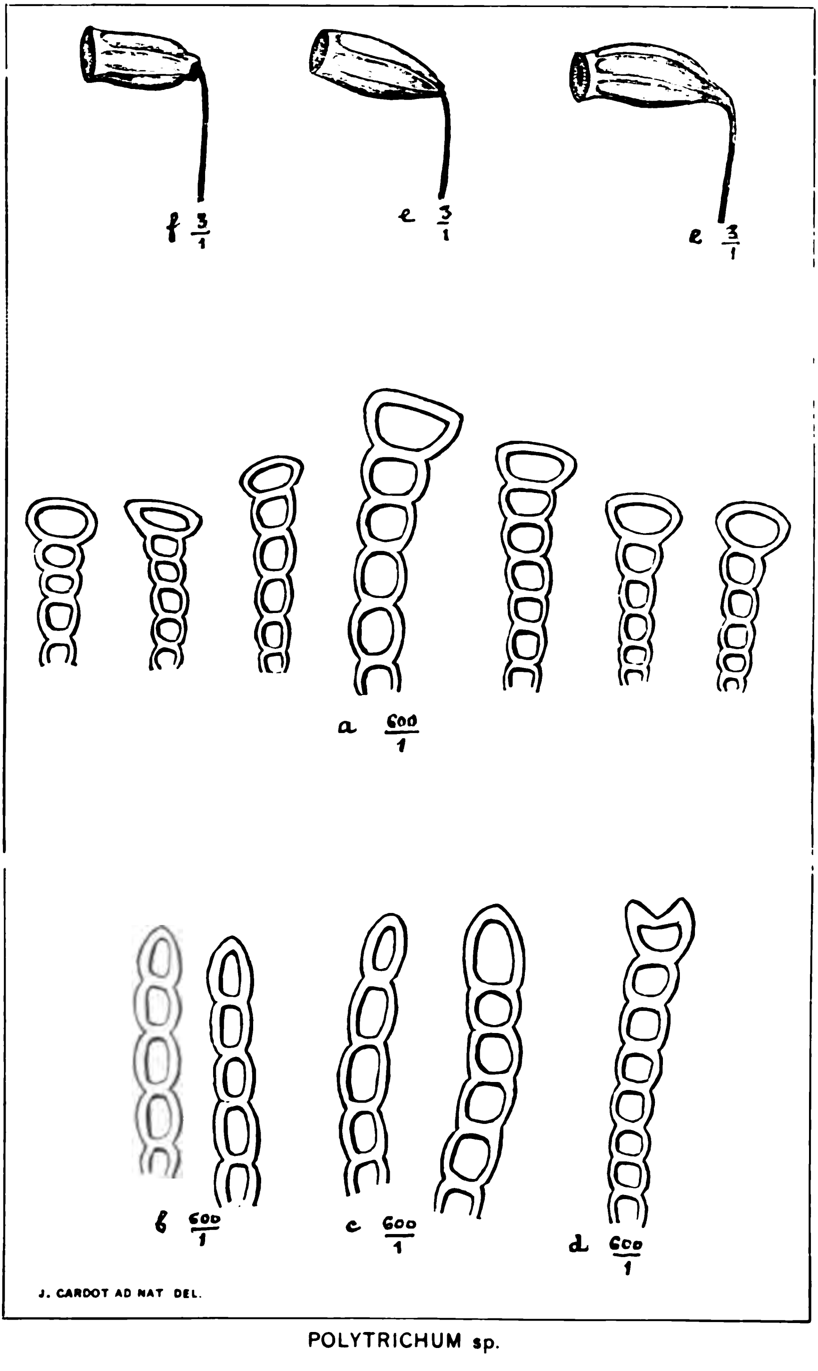
J. CARDOT AD NAT. DEL.

RHACOMITRIUM OREGANUM.

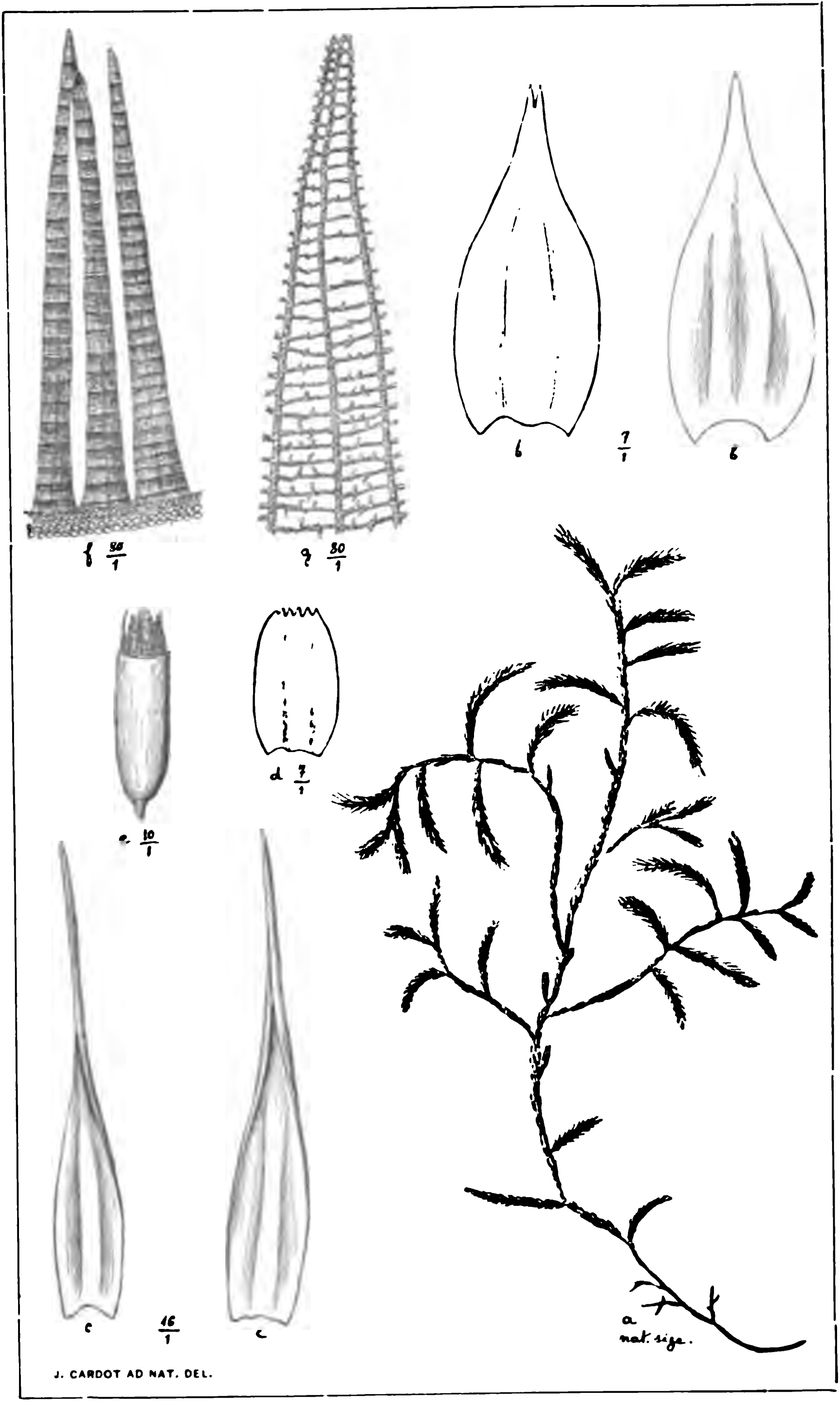


J. CARDOT AD NAT DEL.

WEBERA CAMPTOTRACHELA.

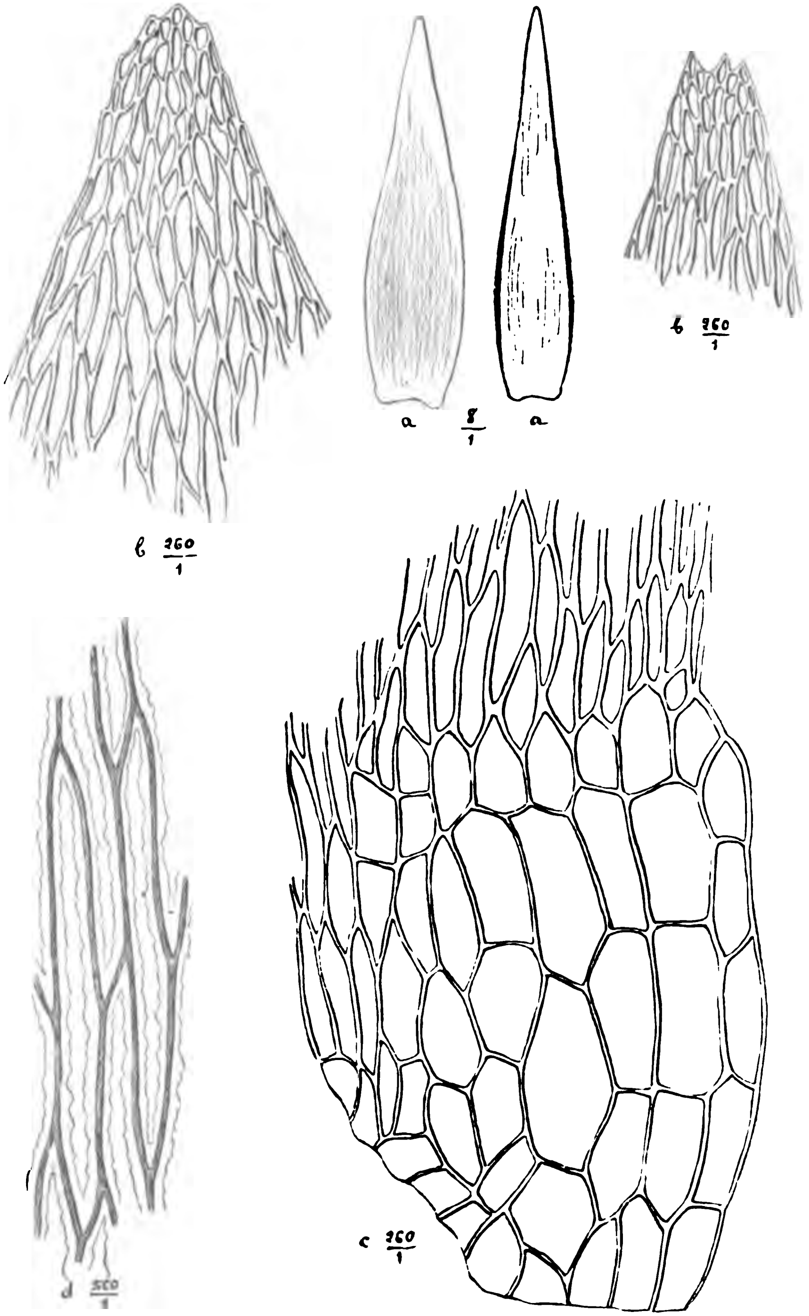


POLYTRICHUM sp.



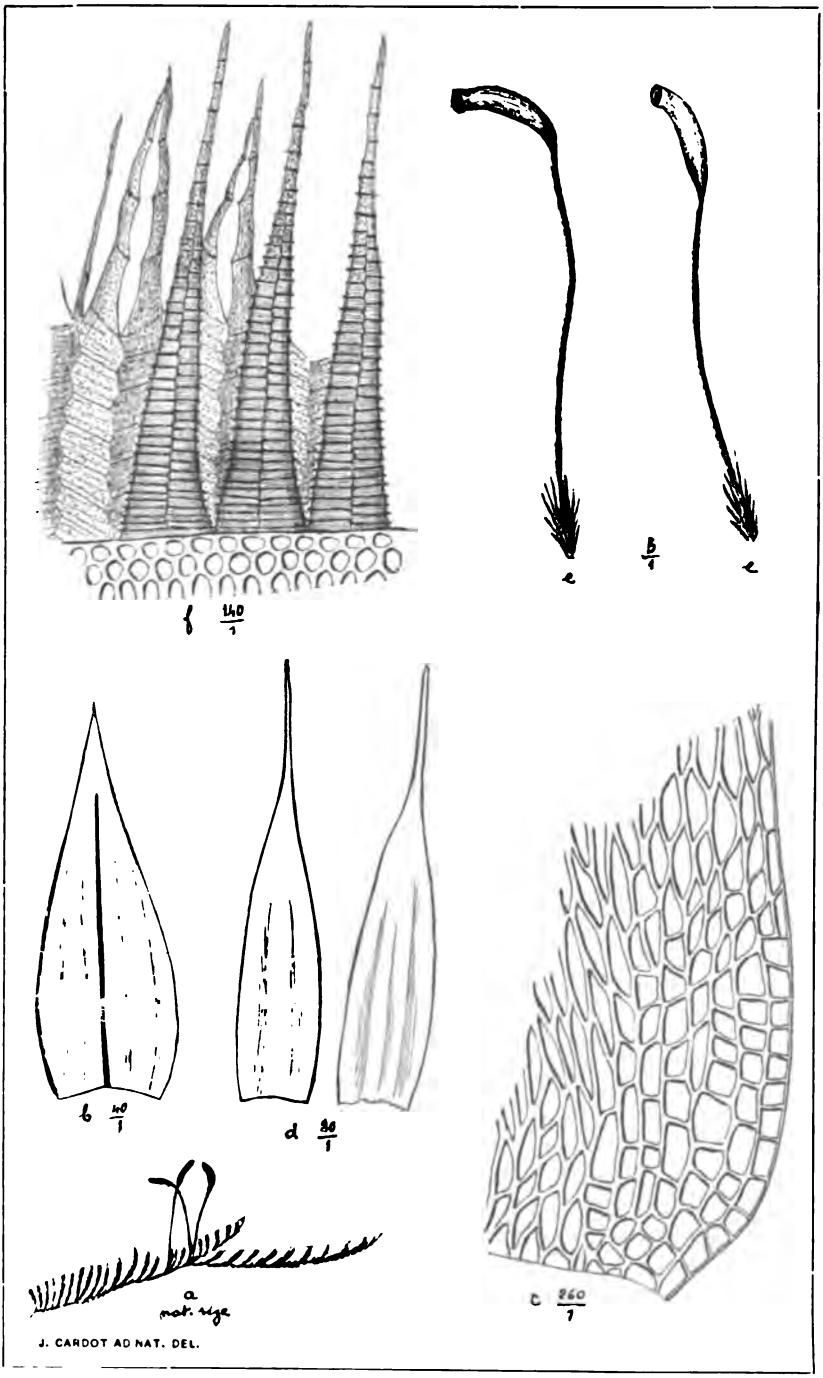
J. CARDOT AD NAT. DEL.

FONTINALIS HOWELLII.



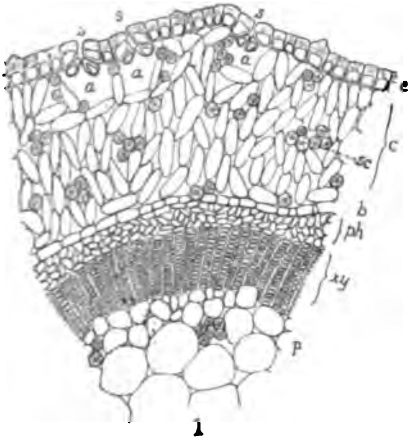
J. CARDOT AD NAT. DEL.

FONTINALIS FLACCIDA.



J. CARDOT AD NAT. DEL.

CAMPTOTHECIUM AMESIÆ.



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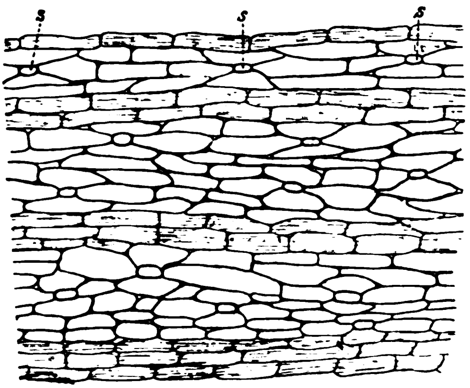

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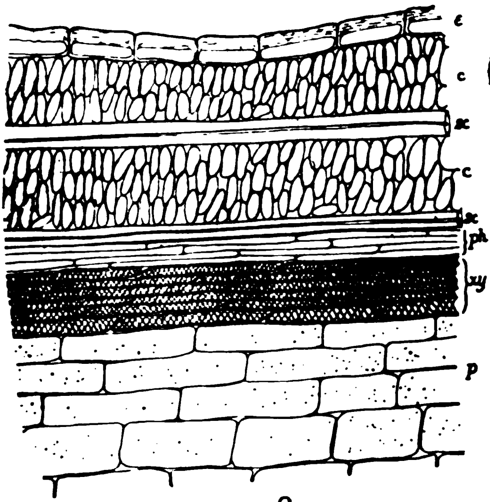

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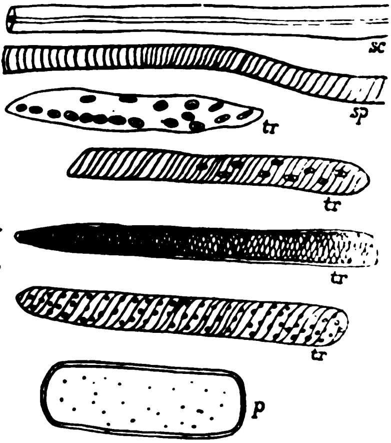

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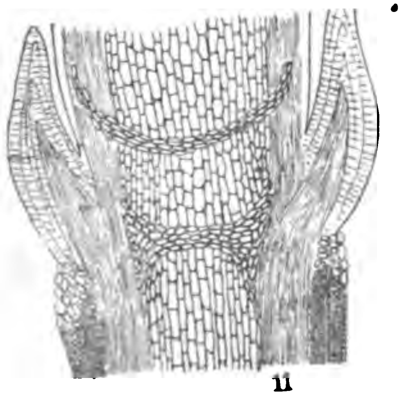

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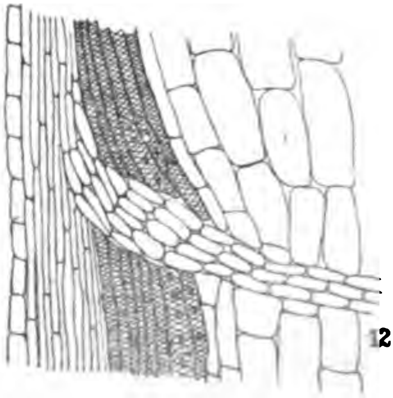
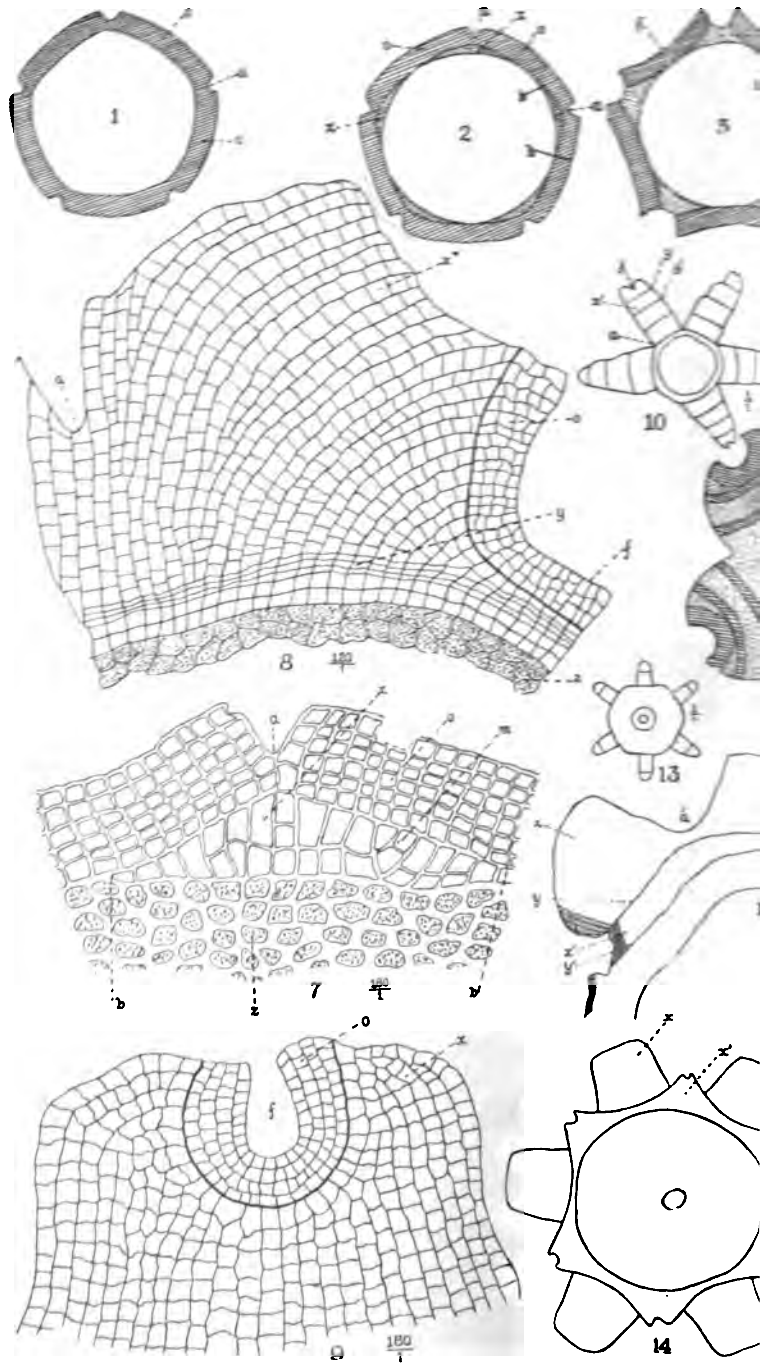


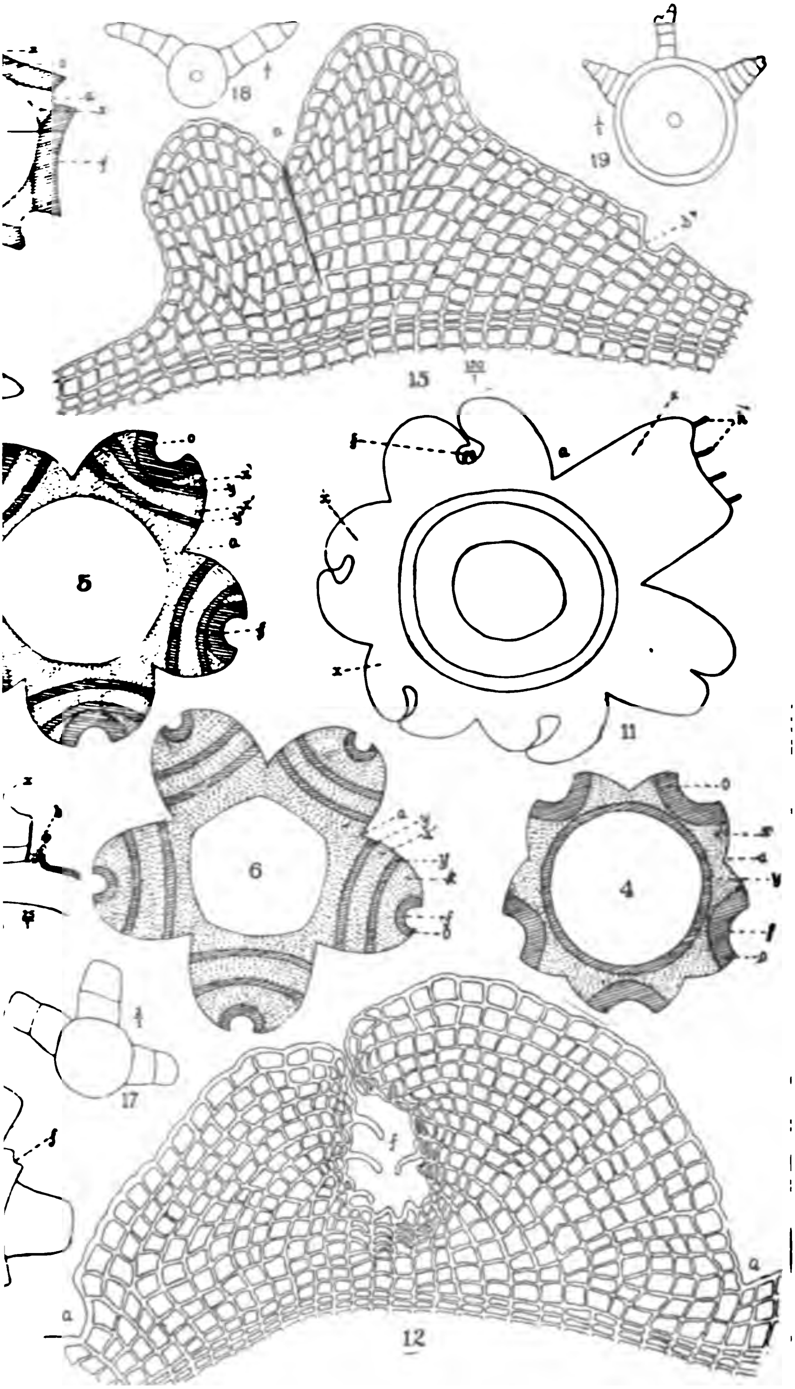
12

EVANS on EPHEDRA



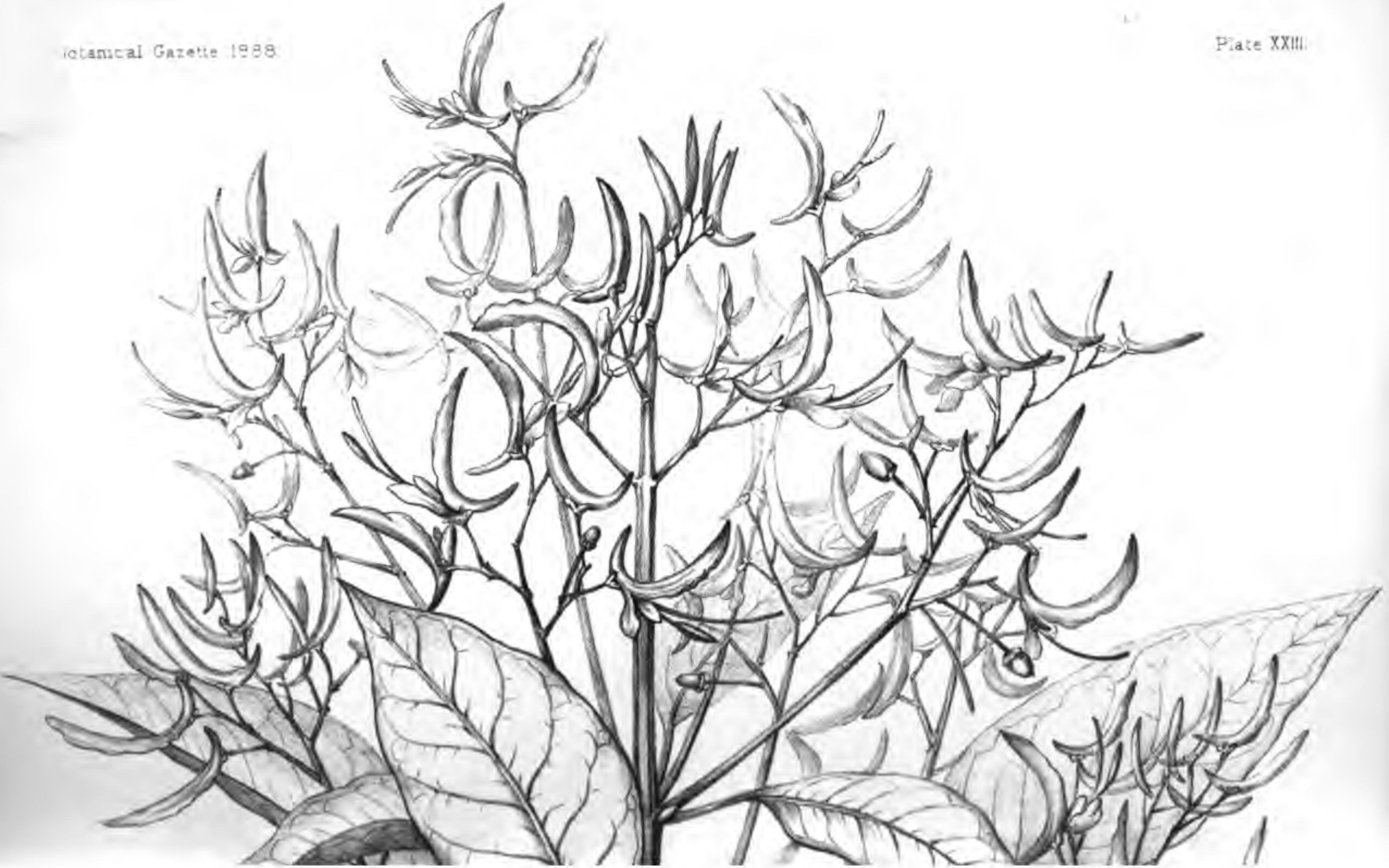
GREGORY ON DEVEL

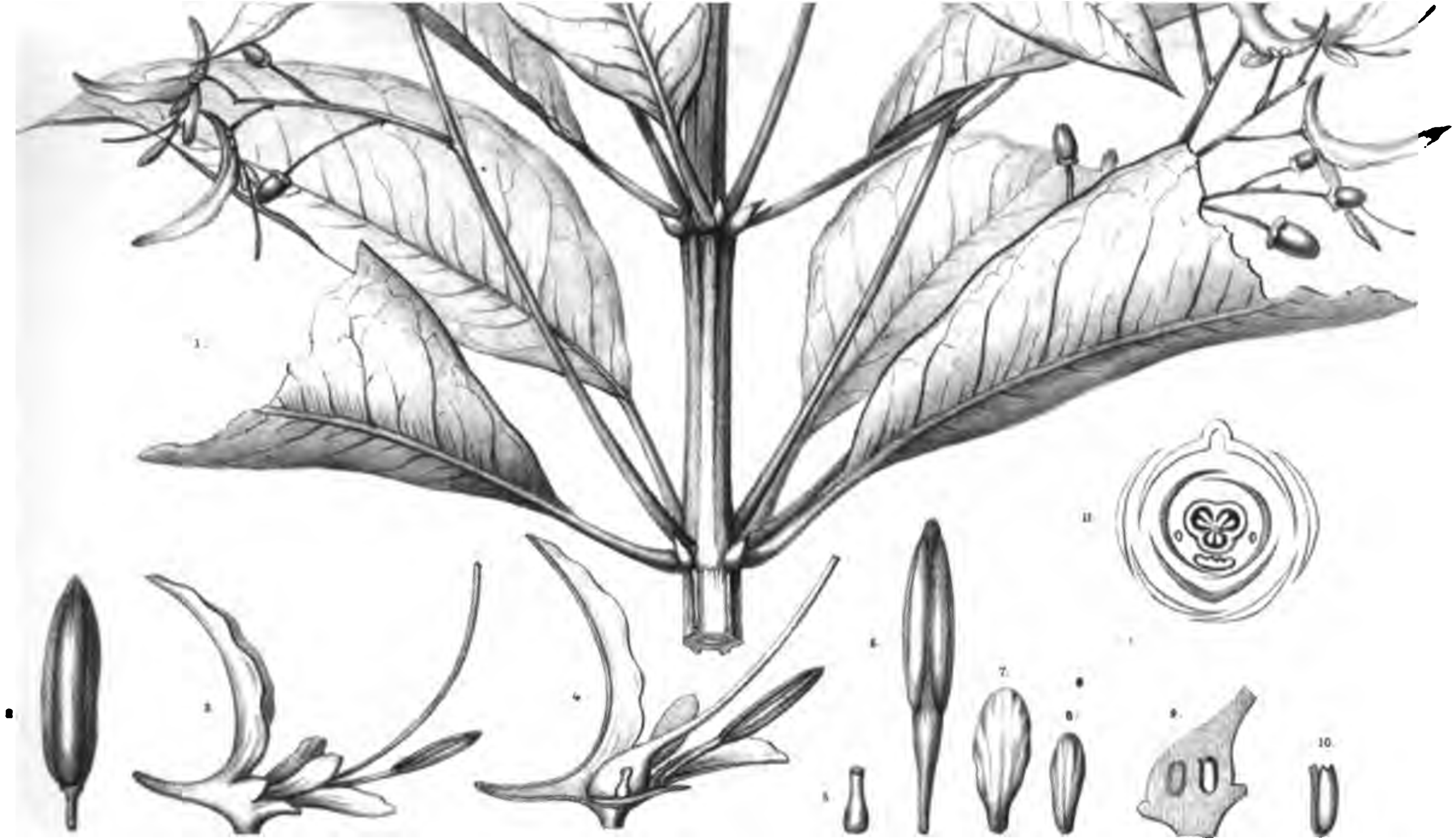
PLATE XXII



PMENT OF CORK WINGS.

otanical Gazette 1888. Plate XXIII.



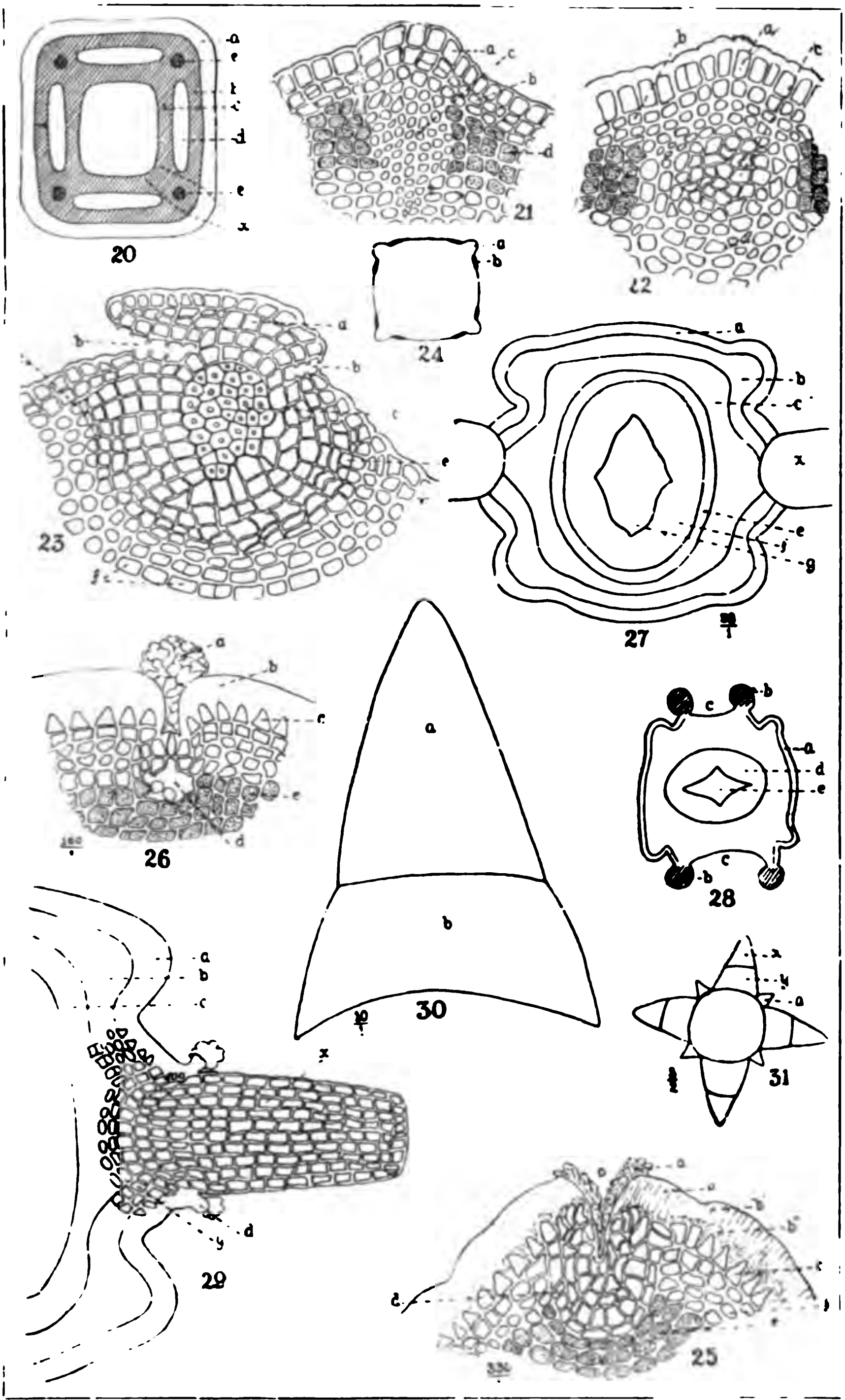


C E Faxon del

B Meisel, Lith Boston

VOCHYSIA GUATEMALENSIS, J Donnell Smith.

BOTANICAL GAZETTE, 1888. PLATE XXV.



GREGORY ON DEVELOPMENT OF CORK WINGS.

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